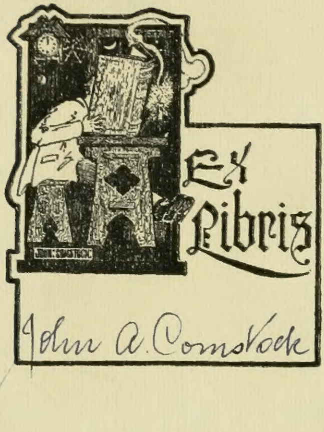
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Libris
John A. Comstock

Forty-Sixth Annual Report

OF THE

Entomological Society

OF ONTARIO

1915

(PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE)

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by A. T. WILGRESS, Printer to the King's Most Excellent Majesty
1916

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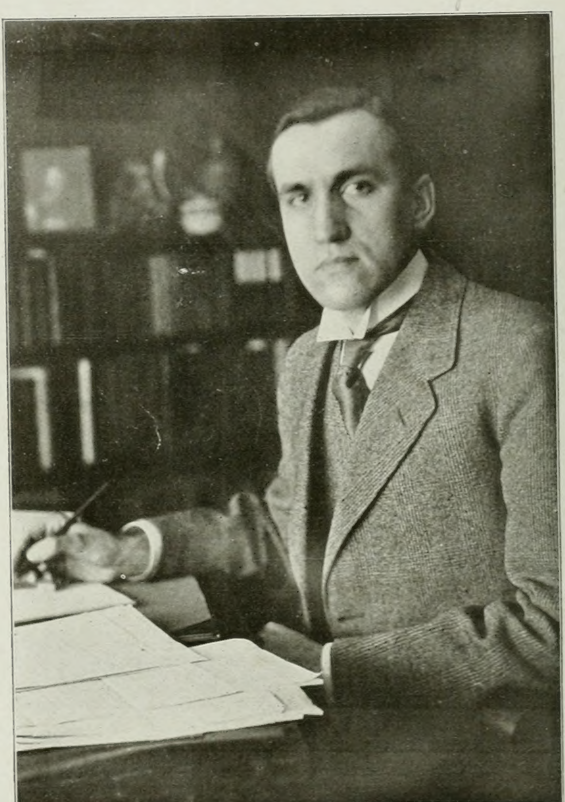

C. Gordon Hewitt, D.Sc., F.R.S.C.
President of the Entomological Society of Ontario, 1913-1915.

To His Honour Sir John Strathearn Hendrie, C.V.O., a Lieutenant-Colonel in the Militia of Canada, etc., etc., etc.,

Lieutenant-Governor of the Province of Ontario.

May it Please Your Honour:

The undersigned begs to present, for the consideration of your Honour, the Report of the Entomological Society of Ontario for 1915.

Respectfully submitted,

JAMES S. DUFF,

Minister of Agriculture.

Toronto, 1916.

CONTENTS

FORTY-SIXTH ANNUAL REPORT

OF THE

Entomological Society of Ontario

1915.

To the Honourable James S. Duff, Minister of Agriculture:

SIR, I have the honour to present herewith the Forty-sixth Annual Report of the Entomological Society of Ontario, containing the proceedings of the Fifty-second Annual Meeting, which was held at Ottawa on November 4th and 5th, 1915. This meeting has been generally recognized as one of the most interesting and successful in the Society's history, and was attended by entomologists from nearly every province of the Dominion as well as from the United States and South Africa.

The reports of the various officers and branches of the Society, together with the papers and addresses presented at the meeting are embodied in the following pages.

The Canadian Entomologist, the Society's monthly journal, has been regularly issued and has now completed its forty-seventh volume. A special feature of this volume is the series of papers on Popular and Practical Entomology, which have appeared in each issue throughout the year.

I have the honour to be, Sir,

Your obedient servant,

EDMUND M. WALKER,

Editor.

Biological Department,
University of Toronto.

Entomological Society of Ontario

OFFICERS FOR 1915-1916

President—Mr. Albert F. Winn, Westmount, Que.

Vice-President—Prof. Lawson Caesar, Dept. of Entomology, Ontario Agricultural College, Guelph.

Secretary-Treasurer—Mr. A. W. Baker, B.S.A., Lecturer in Entomology, O. A. College, Guelph.

Curator—Mr. G. J. Spencer, B.S.A., Demonstrator in Entomology, O. A. College, Guelph.

Librarian—Rev. Prof. C. J. S. Bethune, M.A., D.C.L., F.R.S.C., Professor of Entomology and Zoology, O. A. College, Guelph.

Directors—Division No. 1, Mr. Arthur Gibson, Entomological Branch, Dept. of Agriculture, Ottawa; Division No. 2, Mr. C. E. Grant, Orillia; Division No. 3, Dr. A. Cosens, Parkdale Collegiate Institute, Toronto; Division No. 4, Mr. C. W. Nash, Provincial Biologist, East Toronto; Division No. 5, Mr. F. J. A. Morris, Peterborough; Division No. 6, Mr. J. W. Noble, London, Ont.; Division No. 7, Mr. W. A. Ross, Vineland Station, Ont.

Directors (ex-Presidents of the Society)—Rev. Prof. C. J. S. Bethune, M.A., D.C.L., F.R.S.C., Guelph; W. Hague Harrington, F.R.S.C., Ottawa; Prof. John Dearness, Vice-Principal Normal School, London; Rev. Thomas W. Fyles, D.C.L., F.L.S., Ottawa; Prof. Wm. Lochhead, B.A., M.S., Macdonald College, Que.; John D. Evans, C.E., Chief Engineer, Central Ontario Railway, Trenton; Prof. Tennyson D. Jarvis, Grimsby Beach; Prof. E. M. Walker, B.A., M.B., F.R.S.C., University of Toronto; C. Gordon Hewitt, D.Sc., F.R.S.C., Dominion Entomologist, Ottawa.

Editor of "The Canadian Entomologist"—Prof. E. M. Walker, Toronto.

Delegate to the Royal Society of Canada—Mr. F. J. A. Morris, Peterborough, Ont.

FINANCIAL STATEMENT

For the Year Ending October 31st, 1915

Receipts.		*Expenditures.*	
Balance, 1913-14	$492 32	Cork and pins	$129 99
Dues	85 50	Printing	1,249 01
Subscriptions	439 30	Expense	27 90
Advertising	42 71	Salaries	250 00
Government grant	500 00	Library	77 35
Reports and back numbers	263 01	Annual meeting	86 60
Cork and pins	157 99	Annual report	112 00
Bank interest	9 68	Insurance	26 00
		Bank exchange	7 84
		Balance on hand	23 82
	$1,990 51		$1,990 51

Auditor: J. E. Howitt.

Respectfully submitted,
A. W. Baker,
Secretary-Treasurer.

LIST OF MEMBERS

Ontario.

Addy, Paul H.	Jordan.
Astwood, J. C.	Port Arthur.
Auden, K. F.	Toronto.
Baker, A. W.	Guelph.
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Grant, L. J. M.	"
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Noble, J. W.	Essex.
Petch, C. E.	Ottawa.
Prewett, F. J.	Toronto.
Ross, W. A.	Vineland.
Russell, J. M.	Woodstock.
Sanders, G. E.	Ottawa.
Saxby, J. W.	Toronto.
Sladen, F. W. L.	Ottawa.
Smith, Arthur	Toronto.
Snazelle, C.	"
Snazelle, Chas.	Thornloe.
Spencer, G. J.	Guelph.
Strickland, E. H.	Ottawa.
Thompson, W. R.	London.
Tothill, J. D.	Ottawa.
Walker, Prof. E. M.	Toronto.
Watson, Dr. A. H. R.	Port Hope.
White, James	Snelgrove.
Williams, J. B.	Toronto.
Wood, S. T.	"
Wright, W. H.	Guelph.

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Beaulne, J. J.	Ottawa.
Brainerd, Dwight	Montreal.
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Chagnon, G.	Montreal.
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Corcoran, J. A.	"
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Dunlop, G. C.	Montreal.
Du Porte, E. M.	Macdonald College.
Germain, Bro.	Three Rivers.
Griffin, A.	Montreal.
Gooderham, C. B.	Macdonald College.
Huard, Rev. V. A.	Quebec.
Leopold, Rev. Father	La Trappe.
Letourneau, F.	Oka.
Lochhead, Prof. W.	Macdonald College.
Moore, G. A.	Montreal.
Simms, H. M.	"
Southee, G. A.	"
Winn, A. F.	Westmount.

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Bentley, Lettice	Lethbridge.
Carr, F. S.	Edmonton.
Dod, F. H. Wolley	Midnapore.
Mackie, Donald	Edmonton.
Moodie, Miss	Calgary.
Whitehouse, F. C.	Red Deer.

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Hippesley, Mrs. W. W.	Winnipegosis.
Hunter, Dr. A. J.	Teulon.
Wallis, J. B.	Winnipeg.

Nova Scotia.

Abbot, Winona	Forbes Point
Allan, E. Chesley	Yarmouth.
Baird, W. W.	Nappan.
Brittain, Prof. W. H.	Truro.
Cann, E. Mabel	Yarmouth N.
Conrad, Ethel M.	Halifax.
Craig, I. C.	Amherst.
Creighton, G.	Halifax.
De Wolfe, L. A.	Truro.
Dickey, C. M.	Kentville.
Distant, Mary S.	Halifax.
Dustan, A. G.	Bridgetown.
Gilliatt, F. C.	Granville Centre.
Good, C. A.	Truro.
Goodwin, Alberta	Stewiacke.
Henrion, Miss C.	Halifax.
Jennison, Mary	Truro.
Lindsay, Harriet E.	"
MacPherson, Dr. Hugh	Antigonish.
McGregor, Anna	South River Lake.

NOVA SCOTIA.—*Continued.*

McKay, Dr. A. H.	Halifax.
Mitchell, Lillie J.	"
Moses, Agnes	Brooklyn.
Payne, H. G.	Granville Ferry.
Payne, S. H.	"
Perrin, Joseph	Halifax.
Sanders, G. E.	Bridgetown.
Scott, Prof. J. M.	Truro.
Shaw, Prof. P. J.	"
Shipton, J. W.	Moschelle.
Sinclair, Nellie	South River Lake.
Smith, M. Lois	Truro.
Spittall, J. P.	"
Trevoy, Nellie M.	Brighton.
Wetmore, Ralph	Yarmouth.
Whitehead, W. E.	Kentville.
Whitman, C. F. U.	Lawrencetown.
Williams, C. M.	Nappan.
Young, Ermina	Brighton.
Young, M. E.	Middleton.

SASKATCHEWAN.

Androchowicz, E.	Humboldt.
Hutchinson, H.	Starblanket.
Johnson, G. S.	Moose Jaw.
McCulloch, A. J.	Regina.
Neville, S. J.	Cottonwood.
Willing, Prof. T. N.	Saskatoon.

BRITISH COLUMBIA.

Abbs, A. W.	Vancouver.
Abriel, T.	Nakusp.
Anderson, E. M.	Victoria.
Anderson, J. R.	"
Bain, T. H.	N. Vancouver.
Banks, W. W.	Salmon Arm.
Bird, M. L.	Vancouver.
Blackmore, C. H.	Victoria.
Brand, James	Vancouver.
Brealey, A.	Hatzic.
Brett, W. F.	Armstrong.
Breun, L. A.	Victoria.
Bryant, T.	Ladysmith.
Brydon, J. M.	Victoria.
Bush, A. H.	Vancouver.
Chapman, C.	"
Cockle, J. W.	Kaslo.
Collins, H. W.	Grand Forks.
Cunningham, T.	Vancouver.
Currie, H. B.	Salmon Arm.
Davidson, J. T.	Vancouver.
Day, G. O.	Vancouver Island.
Evans, H. H.	Okanagan Centre.
French, P. E.	Salmon Arm.
Fulton, C.	Kelowna.
Fulton, G. H.	Port Haney.
Gavet, D.	Vancouver.
Gemmel, M.	Sechelt.
Getchell, F. H.	Vancouver.
Hadwen, Dr. S.	Agassiz.
Hanham, A. W.	Duncan's Station.
Hill, Tom	Vernon.
Hoy, B.	"
Hugh, W.	Victoria.
Hunt, E. C.	Creator.
Jackson, W.	Creston.
Kyte, R. J.	Notch Hill.
Leach, D. H.	Salmon Arm
Lyne, W. H.	Vancouver.
Matheson, J. B.	Kelowna.
McCubbing, C.	Salmon Arm.
McKenzie, K.	Kelowna.
Middleton, M.	Nelson.
Mitchell, D.	Tappin.
Palmer, L. L.	Vernon.
Palmer, R. M.	S. Cowichan.
Parham, G. L.	Invermere.
Reed, E. Baynes	Victoria.
Robertson, W. H.	"
Robinson, E. H.	
Ross, A. H.	Nelson.
Rowland, A.	Vancouver.
Ruhman, M.	Vernon.
Russell, D.	Lavington.
Russel, M. W.	Kelowna.
Scott, W. E.	Victoria.
Skinner, E. M.	"
Taylor, L. E.	Kelowna.
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Ward, W. E.	Vancouver.
Whiting, H. H.	Rock Creek.
Wilkerson, G. E.	Victoria.
Wilson, Tom	Vancouver.
Winslow, R. M.	Victoria.
White, E. W.	Sardis.

HONORARY MEMBERS

Cockerell, Prof. T. D. A.	Boulder, Col.
Comstock, Prof. J. H.	Ithaca, N.Y.
Cresson, Ezra T.	Philadelphia, Pa.
Felt, Dr. E. P.	Albany, N.Y.
Howard, Dr. L. O.	Washington, D.C.
Webster, Prof. F. M.	"
Wickham, Prof. H. F.	Iowa City, Ia.

LIFE MEMBERS

Bethune, Rev. C. J. S. Professor of Entomology, Ontario Agricultural College.	Guelph.
Fyles, Rev. Dr. T. W.	Ottawa.
Reed, E. Baynes Director of the Meteorological Station.	Victoria.

The Entomological Society of Ontario

ANNUAL MEETING

The Fifty-second Annual Meeting of the Entomological Society of Ontario was held at Ottawa on Thursday and Friday, November 4th and 5th, 1915. The President of the Society, Dr. C. Gordon Hewitt, occupied the chair. Among the members present were: Dr. H. T. Fernald, Amherst, Mass.; Mr. A. F. Burgess, Melrose Highlands, Mass.; Professor C. P. Lounsbury, Pretoria, South Africa; Dr. Hugh Glasgow, Geneva, N.Y.; Rev. T. W. Fyles, Ottawa; Dr. C. G. Hewitt and Messrs. Arthur Gibson and J. M. Swaine, Entomological Branch, Ottawa; Messrs. R. C. Treherne, G. E. Sanders, J. D. Tothill, E. H. Strickland, N. Criddle, G. Beaulieu, W. A. Ross, J. R. Gareau, C. E. Petch, R. N. Chrystal, and L. S. McLaine, Field Officers of the Entomological Branch; Prof. L. Caesar, Prof. E. J. Zavitz, and A. W. Baker, of Guelph; Prof. W. Lochhead, E. M. Duporte and T. Rankin, of Macdonald College; Prof. W. H. Brittain, Agricultural College, Truro, N.S.; Tom Wilson, Vancouver, B.C.; F. J. A. Morris, Port Hope, Ont.; A. F. Winn, Montreal; J. C. Chapais, St. Denis-en-bas, Que.; H. G. Payne, Kentville, N.S.; H. G. Crawford, Wilton Grove, Ont.; Rev. Father Leopold and Professor Letourneau, of La Trappe, Que.; Chas. MacNamara, Arnprior, Ont.; and Sir James Grant, Prof. E. E. Prince, Dr. T. Torrance, Dr. C. H. Higgins, Dr. F. T. Shutt, W. T. Macoun, R. H. Campbell, H. T. Gussow, W. Ide, D. Johnson, F. W. L. Sladen, V. Kitto, A. E. Kellett and J. I. Beaulne, Ottawa.

THURSDAY, NOVEMBER 4TH—MORNING SESSION.

The President: In opening our general session, I should like to welcome you all to Ottawa. This is an unusual meeting for a number of reasons. It is not the first meeting we have had in Ottawa—but it is an unusual meeting in that we have here for the first time all the officers of the Entomological Branch. Secondly, it is an unusual meeting as we have with us, and are honored by the presence of, Mr. C. P. Lounsbury, the Government Entomologist for the Union of South Africa. The surpreme nature of his visit prevented the appearance of his name on the programme, but that will not release him from taking part in our deliberations. He will probably have something to say later on. I, as President, did not prepare anything in the nature of an address for this meeting as we have a rather long programme. In the course of the proceedings I shall probably have a little to say regarding the progress of our work and of entomology in Canada generally. We have a certain amount of business to complete before our real session begins and I will now call upon the Secretary to read the Report of the Council.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1914-15.

The Fifty-first Annual Meeting of the Society was held in Toronto on Thursday and Friday, November 5th and 6th, 1914. The meeting of the Council was held in the Biological Building of the University of Toronto, and the general

meetings were held at the Royal Canadian Institute. The President, Dr. C. Gordon Hewitt, occupied the chair during the sessions.

The annual meeting of the Council was held on Thursday morning. Numerous business matters were discussed and a recommendation was made to the Society that the next annual meeting be held in Ottawa.

On Thursday afternoon the Reports of the Directors on the insects of the year were read. Dr. Hewitt then delivered the Presidential address on "The Rise and Progress of Applied Entomology in Canada." Prof. Caesar then delivered a paper on the "Insects of the Season in Ontario."

On Thursday evening in the Biological Lecture-room of the University Prof. J. H. Comstock, of Cornell University, delivered the Public Lecture on the "Habits of Spiders." The lecture was extremely interesting and was extensively illustrated with magnificent lantern slides.

The business meeting of the Society was held on Friday morning at 9.30. The reports of the various officers and branches of the Society were read and adopted. The remaining time of the morning and afternoon meetings was occupied with the reading of the following papers:

"The Work of Fabre," Prof. Lochhead, Macdonald College, Que.

"Injurious Insects of Quebec in 1914," Prof. Lochhead. (Read by title.)

"Injurious Insects of Southern Quebec," Mr. C. E. Petch, Ottawa. (Read by title.)

"Outbreak of the Army-worm in Canada in 1914," Mr. Arthur Gibson, Ottawa.

"The Army-worm in Ontario in 1914," Mr. A. W. Baker, Guelph.

"Mountains and Hills," Dr. Fyles, Ottawa.

"Variation in colour in the bristles of the Hedgehog Caterpillar, Isia isabella," Mr. Arthur Gibson, Ottawa.

"Locust Control in Eastern Canada," Mr. Arthur Gibson, Ottawa.

"An Imported Red Spider attacking fruit-trees," Prof. Caesar, Guelph.

"The Entomological Record, 1914," Mr. Arthur Gibson, Ottawa.

"Forest and Shade-tree Insects of the Farm," Mr. J. M. Swaine, Ottawa.

"Cherry Fruit-flies," Prof. L. Caesar, Guelph.

The Canadian Entomologist, the official organ of the Society, has been published regularly each month. The forty-sixth volume of the magazine was completed in December, 1914. It consisted of 446 pages and was extensively illustrated. This is the largest volume to date.

The Annual Report of the Society contained the proceedings of the annual meeting and formed a valuable edition to our entomological literature.

The regular meetings of the Society were reduced in number owing to military activities at the Ontario Agricultural College. The meetings were chiefly of a business character, but during the year the following papers were read:

"Some interesting points in the Army-worm Outbreak of 1914," Mr. A. W. Baker.

"The Study of Entomology," Prof. L. Caesar.

"Laboratory Methods in Collecting, Preserving and Dissecting Insects," Mr. G. J. Spencer.

The records show that twenty-four new members have been added to the rolls of the Society during 1914-15. The reports of the branches of the Society for 1913-14 all showed a successful year. It is with much pleasure that the Council records the formation, due largely to the efforts of Prof. W. H. Brittain, of a large and flourishing branch of the Society in Nova Scotia.

REPORT OF THE CURATOR.

The collections of the Society have been examined from time to time during the past year and kept free from museum pests.

With a view to supplying in a small way the sad need of Diptera, Hemiptera and Hymenoptera, special collections were made this summer and, as soon as the material can be identified and labelled, it will be added to the collections.

Contributions of these orders to the Society collections from members will be greatly appreciated.

G. SPENCER, *Curator.*

REPORT OF THE LIBRARIAN.

During the year ending October 31st, 1915, seventeen bound volumes have been added to the library, making the number on the register 2,220. A large number of unbound pamphlets, bulletins, reports and periodicals have been received from authors and publishers and in exchange for *The Canadian Entomologist*. No binding has been done during the past year.

Among recent additions to the library may be mentioned the following: Packard's "Monograph of the Bombycine Moths of North America, Part 3"; Sir G. Hampson's "Catalogue of the Lepidoptera Phalænæ in the British Museum," Vol. 13 and supplementary vol. 1; Fletcher's "Some Indian Insects"; Slingerland and Crosby's "Manual of Fruit Insects"; Pierce's "Genitalia of British Geometridæ."

Reference to the library is constantly being made by the staff and students of the Biological Departments of the Ontario Agricultural College, and books are from time to time taken out by members of the Society at a distance.

Respectfully submitted,

CHARLES J. S. BETHUNE, *Librarian.*

REPORTS ON INSECTS OF THE YEAR.

DIVISION NO 1, OTTAWA DISTRICT—ARTHUR GIBSON, ENTOMOLOGICAL BRANCH, OTTAWA.

ATTACKING FIELD CROPS.

LOCUSTS. These insects were again very abundant in eastern Ontario. The young locusts began to appear towards the end of May, but owing to dull, cool weather conditions did not become active until the first and second weeks of June. The Lesser Migratory Locust (*Melanoplus atlanis*) was the chief destructive species. It was accompanied in noticeable numbers by the Pellucid Locust (*Camnula pellucida*). These two species are frequently found working together. Near Bowesville, Ont., where we continued our work on control with poisoned baits, the insects were present in countless thousands. The crops attacked were chiefly oats, barley, timothy, buckwheat, clover, tobacco, potatoes, and corn. In

one instance near Ottawa about 6,000 celery plants were destroyed. On page 156 will be found a brief account of our 1915 work with poisoned baits.

CUTWORMS. The two species which in 1915 effected most damage in the Ottawa district are the Common Striped Cutworm (*Euxoa tessellata*), and the Dark-sided Cutworm (*Euxoa messoria*), both of which were very abundant the previous season. Vegetable and flowering garden plants were freely attacked. The former was the chief culprit and destroyed first sowings of beets, carrots, onions, etc. To a lesser extent the Red-backed Cutworm (*Euxoa ochrogaster*) was also present, being reported specially by vegetable growers. The Kansas grasshopper formula (Bran 20 lbs., Paris green 1 lb., molasses 2 quarts, oranges or lemons 3, water 2½ gallons*) this year gave excellent results at Ottawa for the control of cutworms. In one large field of onions the outbreak was stopped immediately. When scattered thinly the 20 lbs. may be used to treat about 3 acres, the application to be made after sundown. In one field of corn cutworms were plentiful and an application of the above mixture was made. Further injury was thus prevented and an examination made around 40 hills by Mr. Bryce, of Macdonald College, resulting in the finding of from 1 to 6 dead cutworms near each hill.

ROOT MAGGOTS. The three species, viz., THE CABBAGE MAGGOT (*Phorbia brassicæ*), the IMPORTED ONION MAGGOT (*Hylemyia antiqua*), and the SEED-CORN MAGGOT (*Phorbia fusciceps*), were all present in the Ottawa district in 1915, the two former causing much loss. The latter was reported attacking beans in small gardens. The Cabbage Maggot was particularly destructive to cauliflowers, cabbages, turnips and radishes. One market gardener near Ottawa reported the loss of 3,500 early cauliflowers. In continuing our work on the control of this insect we again demonstrated the value of the one-ply tarred felt paper disc. In one experiment about 1,600 plants had the discs placed around their stems and practically the whole crop was protected from maggot attack. The control of these root maggots is discussed in full in a bulletin which we have just prepared and which we hope will be available for distribution in the spring of 1916.

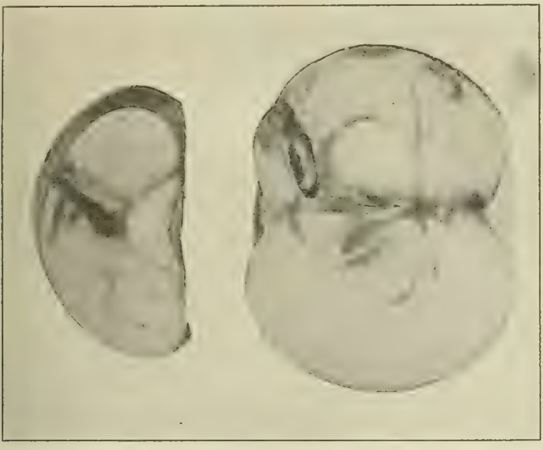
THE ASPARAGUS BEETLES. In September 1906, we found at Ottawa the larvæ of the COMMON ASPARAGUS BEETLE (*Crioceris asparagi* L.). Until 1915, this was the only record we had for the district. During the past season, however, the insect was abundant and destructive, and it was accompanied by the TWELVE-SPOTTED ASPARAGUS BEETLE (*Crioceris 12-punctata* L.). The year 1915 is the first in which we have found this latter species at Ottawa. The adult beetles were commonly found in the latter half of August. The larvæ of the latter species were collected from the seeds of asparagus on September 23rd. Growers of asparagus in the Ottawa district should watch for the appearance of these beetles in spring and apply the well known remedies.

THE ASH-GRAY BLISTER BEETLE (*Macrobasis unicolor* Kirby). Large numbers of this insect were observed in eastern Canada, near Ottawa, and also in parts of Quebec Province, where locusts had been destructive. In one field of potatoes which I examined in the latter half of June the beetle was present in thousands and the vines were conspicuously defoliated. At Bowesville, near Ottawa, Mr. T. Rankin found the insect abundant in early July. In addition to potatoes this blister beetle attacks beans, peas, beets, tomato, clover, etc.

*In preparing the bran mash the bran and Paris green are mixed thoroughly while dry. The juice of the oranges or lemons is squeezed into the water, and to this is also added the pulp and peel after cutting into fine bits. The molasses should then be added, and when dissolved the mixture should be poured on to the dry bran and poison, stirring the whole constantly so as to dampen the bran thoroughly.

The Red-headed Flea Beetle (*Systena frontalis*). In the middle of August this common black flea-beetle was seen at Ottawa to be attacking potatoes, and in flower gardens asters and chrysanthemums were injured. It was also found on carrot. It may be easily recognized by the conspicuous red patch on the top of the head; in length it is about three-sixteenths of an inch. Potato vines which are properly sprayed to protect them from the Colorado Potato Beetle would, of course, also be protected from the ravages of the Red-headed Flea Beetle.

Pea Aphis (*Macrosiphum pisi*). In eastern Ontario a rather serious outbreak of the pea aphis occurred, and from a few places reports of injury by the Carrot Rust Fly (*Psila rosæ*) were received.



Illustrating larva of Dock Sawfly, *Ametastegia glabrata* (*Taxonus nigrisoma*) and its habit of boring into apples in autumn in which to hibernate. (Original.)

Attacking Fruit Trees.

Aphides. These insects were present in large numbers during the season, many enquiries being received particularly with regard to the species occurring on plum and apple.

The Oyster-shell Scale (*Lepidosaphes ulmi* L.) was frequently reported, but few instances of noticeable damage by the Codling Moth (*Cydia pomonella*), came to my notice.

The Dock Sawfly (*Ametastegia glabrata* Fallen). During 1915 this insect, which in Canadian literature was previously known as *Taxonus nigrisoma* Nort., was abundant throughout eastern Canada, and its well-known habit of boring into apples in autumn was complained of. The same injury was noticed at Ottawa. In 1902, Fletcher* first recorded such injury to apples in Ontario, which was also in that year observed at Ottawa. The larva, which is known as the Dock False-worm, usually feeds on plants of the Dock family. Its habit of boring

*33rd Annual Report of the Ent. Soc. of Ontario.

into the soft flesh of apples in autumn to hibernate is shown in figure 1. In one apple examined in September last two larvæ were found. The holes where the larvæ had entered were conspicuous. Several apples were examined and, in one, three holes occurred close together. An examination of these indicated that the larva evidently has the habit of boring several holes before finally closing one up in which to pass the winter. In one case the cavity in the apple was five-eighths of an inch long by one-eighth of an inch wide. The end was closed up with the "chewings" made by the larva, no frass being present. In another instance the larva had entered to a distance of nine-sixteenths of an inch and in still another eleven-sixteenths of an inch. In every case the head of the larva was towards the skin or outside of the apple. The larva was one-half inch in length, dark green in colour, the sides and centre whitish green; head pale brown, darker brown at vertex, on either side a conspicuous dark brown spot. In the December, 1915, number of the Proceedings of the Entomological Society of Washington, Rohwer places the name we knew the insect by, viz., *Taxonus nigrisoma* Nort., as a synonym of the European species, *Ametastegia glabrata* (Fallen).

Greenhouse and Garden Plants.

Garden plants of many kinds suffered seriously from the attacks of plant lice, and in early spring newly set out annuals were cut off by cutworms, the Striped Cutworm being the most destructive of the species which occurred in 1915.

The Four-lined Leaf Bug (*Pœcilocapsus lineatus* Fab.) was abundant in the district, attacking freely such garden plants as asters, dahlias, etc.

The Red-headed Flea Beetle (*Systena frontalis*). As already mentioned, this common flea-beetle was found this year in August attacking asters and chrysanthemums.

The most interesting greenhouse insect of the year at Ottawa was the occurrence of the Chrysanthemum Midge, (*Diarthronomyia hypogæa* H.Lw.) in one of the large houses. This insect had doubtless been recently introduced with the plants from the United States, where it has become recently established. The Ottawa occurrence is the only record we have of the midge in Canada. Dr. Felt,* the New York State Entomologist, in writing of the species in April, 1915, recommends the destruction of badly infested plants by burning. Where the leaves only show slight infestation many of these may be removed. Fumigation with hydrocyanic acid gas would, of course, destroy the midges but would have little or no effect on the larvæ, which work within the leaf tissues.

Division No. 3, Toronto District—A. Cosens.

So far as the writer is concerned, the Entomological season of 1915 opened April 7th with a trip to the Etobicoke, a small stream that enters Lake Ontario a few miles west of the city. The banks of this creek are still wooded in many places, and even yet the Indian significance of the name, "the place of the Alder," is peculiarly applicable. The locality was choice, but a delightfully warm sun and the lethargy incident to the first tramp of the year made energetic collecting almost an impossibility. This and the early date serve as an explanation of the confession that the only insects captured were specimens of *Aphodius femoralis* Say., many of which were on the wing.

The excessive rainfall and the low average temperature of the past summer do not appear to have reduced materially the production of the various forms

*Jour. Econ. Ent., Vol. 8, 267.

of insect life. Some orders were relatively poorly represented in the early part of the season, but later on became normally abundant. With the exception of the Cabbage-butterfly, other species were not so common as usual, until about the end of August, when several forms began to appear in larger numbers. At Mt. Dennis, Oct. 11th, many specimens of Milbert's Tortoise-shell, *Vanessa milberti* Godart, were flitting about or resting upon the heads of the large purple aster, the flower and insect combination adding a pleasing touch of color to the otherwise rather sombre tints of the frost-touched vegetation. After about the middle of July the Baltimore, *Melitaea phaeton* Drury, was fairly plentiful. As a general rule, both of these species are comparatively rare in this district.

The damage done this year by several injurious insects has been more pronounced than usual.

At the beginning of the season, the webs of the Tent caterpillars were frequently seen on the Choke Cherries and other native trees of the fence rows and thickets in the vicinity of the city. From complaints received from fruit growers, it would seem that this pest has lost none of its wonted energy, and is still an important issue from an economic standpoint.

The continuous wet weather is credited by many with the greatly increased activity of the Carrot Rust Fly, *Psila rosae*. A gardener of many years' experience, who had never noticed the pest before, had his crop completely ruined by its ravages. In some cases the larvae had so tunnelled the carrot that the entire cortex was destroyed; it was impossible to find a single plant that was not attacked. For the benefit of others who may have crops similarly affected, I take the liberty of quoting the directions, kindly sent by Mr. Gibson, for bringing the insect under control. "Protection against the attack of the insect may be obtained, early in the season, at the time the plants are thinned out, by spraying with the ordinary kerosene emulsion, diluted one part in nine of water. Where carrots are stored in sand for winter use, the larvae leave the roots and pupate in the soil. In spring, of course, such sand in which the puparia occur should be removed and buried in a deep hole or thrown into a pond. It is wise to use land next year in which the carrots were not grown during the present season."

Sawfly larvæ were received from Mr. Blakely, of the Parks Department, who reported that they were damaging the California poplars in the eastern part of the city. Several trees were attacked by them, and the leaves badly eaten. These larvæ have a ground colour of yellow, broken by two pairs of lateral rows of black spots. In the upper series, these are irregularly circular in outline; in the lower, while of nearly the same shape, they are much smaller. The vertex of the head is black, shading to a deep brown at the front and sides. All the mouth-parts are yellow, with the exception of the mandibles, which are black. A black spot covers the dorsal portion of the last segment. The whole body bears a covering of long light-yellow hairs. The larvæ are gregarious feeders. Mr. S. A. Rohwer, Washington, to whom specimens were sent, writing under date of Sept. 27th, replied as follows:

"Yours of the 25th instant reached me this morning. The sawfly larvæ that you sent cocooned en route, but I do not doubt in the least that it is *Trichiocampus viminalis* (Fallen), a species that is treated under the name of *Aulacomerus lutescens* by Lintner in the fourth report of the State Entomologist of New York, pages 44-46. As far as I am aware, this is the first report of this species being of economic importance. The larvæ cocoon in the leaves, or the cocoon is attached along the trunk of the tree. Lintner found two generations, and this is probably

the last. The best control measures to be adopted would be the raking up and burning of the leaves."

The Lesser Bud-moth, *Recurvaria nanella.* Larvæ of this Europeon species were found in numbers at Toronto, on a pear tree; and an apple tree in an adjoining lot had all the leaves rolled up by the larvæ. The species was determined by Mr. August Busck. The insect is discussed at length in Bull. 113 of the United States Department of Agriculture.

A large percentage of the grasshoppers, examined during September, were found to be parasitized by "hair snakes" of either the genus *Gordius* or *Mermis,* the latter being more numerous. The Red-legged Grasshopper, *Melanoplus femur-rubrum* De G., was the favorite host in this district. It would seem a reasonable conjecture that the wet season has had, in this case, a deterring effect on the production of the grasshoppers by furnishing more suitable conditions for the development of this parasite, but the dexterity with which the infected specimens evaded a net has given me grave cause to doubt the efficiency of this check. At least it seemed impossible to distinguish parasitized from unparasitized forms by any lessened activity on the part of the former.

Throughout July, the unusually wet weather must have produced ideal conditions for the maturing of aphids, as these insects were forced upon the attention at all times. Many different species of plants were infested, the spiraeas and roses of the city gardens were often seriously injured by them, and even the burdocks and lamb's quarters, of the vacant lots, were not immume from their attacks. Masses of a small black species surrounded the stems and leaf petioles of the common nasturtium, in many cases killing the smaller plants. Another variety established colonies on the flower clusters of the honeysuckles, and destroyed the majority of the unopened buds. Especially in the case of infected roses, a number of different remedies were applied. Some growers apparently had implicit faith in the effectiveness of an "absent" treatment, and did nothing at all, to the detriment of their own and their neighbor's plants. Others were firmly convinced that spraying with cold water was all that was necessary, while a few substituted a solution of nicotine. This last method appeared to give universal satisfaction wherever it had been properly tried. One gardener did, however, assure me that his bushes had developed a particularly hardy variety of aphid that refused to succumb even to the nicotine application.

A very interesting root gall was collected early in the spring by Prof. J. H. Faull, University of Toronto. The galls, which are produced on the roots of the False Solomon's Seal, *Maianthemum canadense,* Desf., consist of elongated swellings, from 8-12 mm. in length, and 2-3 mm. in diameter. They are circular in cross-section, and fairly regular in shape, tapering gradually at each end to the size of the normal rootlet. As the specimens were immature when secured, it was necessary to keep them under moist conditions for several weeks. This may account for the fact that only four producers were secured from a dozen galls. The insects were sent to Dr. E. P. Felt, Albany, N. Y., who has pronounced them a new species, and is describing them under the name *Dasyneura torontoensis.* The only information that we possess, concerning the life histories of the adults, is that they emerge late in June. The light color of the insects would seem to indicate that the greater part of their existence is spent underground.

DIVISION NO. 5, PORT HOPE DISTRICT—FRANCIS J. A. MORRIS.

An active collector of Lepidoptera in Port Hope, Mr. H. L. Bowers, has now moved to Oshawa and reports an unprofitable season's work due to bad weather and unfamiliarity with his surroundings. He writes:

I collected pretty steadily until June 15th, but took few specimens, Oshawa being a poorer hunting ground than Port Hope. Extreme wet seemed to keep insect pests in the background. "*Pieris rapae*," owing to spread of wild mustard, seems on the increase; in September the fields were white with them; milkweed butterflies were more numerous than last year; other butterflies were scarce: such scarcity has been remarkable the last two or three seasons. During 1912 I could have taken hundreds of *Vanessa J-album*, but have seen few since. Tent caterpillars, both American and forest, were more numerous this year than last. Many orchards around Oshawa were completely defoliated. I was interested to see how much these were parasitized, and out of 100 cocoons, I did not find one thus suffering. Pistol case-bearer of the apple was very plentiful. I noticed many apple trees badly infested with aphids. The tendency to allow wild apple, cherry and plum to grow unchecked has a great tendency to render means taken by progressive orchard-men to keep down insect pests, largely abortive. Practically all of the wild apple trees that I have seen around Oshawa have been heavily infested with the Oyster-shell scale. In September, I saw many cherry trees near Newtonville badly eaten by pear-tree slug (*Selandria cerasi*). The caterpillars of certain species of *Crambus* were very numerous in meadows. I noticed the maple trees in Oshawa badly infested with Pigeon Horn Tail, which oviposited continuously from August 3rd to September 15th; *Thalessa lunator* was also plentiful. Hemlocks on the main street were badly infested with *Tortrix fumiferana*. Some horse-chestnuts were badly eaten by tussock caterpillars. The Promethea moth, found very scarce at Port Hope (one cocoon in six years), seems plentiful here. I took *Phigalia titea*, April 13th; *Orthofidonia vestaliata* were plentiful for several weeks; *Drepana arcuata*, May 30th; *Sphinx cerisyi*, June 13th; *Thecla liparops*, July 18th. I have identified some of the captures made last year, and the following is a list of those made at Port Hope, which have some interest. I believe they are all fairly scarce:—

Sphinx cerisyi.
Diphthera fallax.
Hyperaeschra georgica.
Fentonia marthesia.
Galgula hepara.
Catocala innubens.
Catocala vidua.
Raphia pater.
Semiophora opacifrons.
Semiophora tenebrifera.
Hydriomena ruberata (*birivata?*).
Thecla edwardsii.

Dr. Watson of Port Hope reports the cutworm locally troublesome on cabbage and cauliflower.

Mr. Duncan, of the Department of Agriculture in Port Hope, says the Potato Beetle was very prevalent and that he noticed in several places the Friendly Perillus at work destroying the larvæ. Aphids were not so abundant. He was called to look at an apple orchard near Orono that was overrun by Tent caterpillars. It was ten or twelve acres in extent, and most of the trees were denuded of foliage and bore no fruit, except in the one corner that he was able to save by spraying with arsenate of lead. Some idea of the numbers of these creatures could be gathered from a sack that he saw slung over a branch in the orchard: *ex pede Herculem*—in the folds of the sack he counted over fifty cocoons. His recollection is that both species of caterpillar were equally numerous. The orchard was a well-kept one and had not been attacked in 1914. This, again, points in the same direction as Mr. Bowers' note. There were doubtless rich breeding grounds along some nearby fences the year before, or even that same season, but the larvæ ran out of food and like many another young innocent crept into the apple orchard. The canker worm was also prevalent in the orchard.

The school collections of insects, Mr. Duncan says, were up to average and a few collections were extensive and well arranged. In the Peterborough Collegiate 30 or 40 of these come in annually and I often find specimens of great

interest among them. This year the families of American Silk-worm moths and of Sphingidæ were remarkably well represented. Among the latter was a very beautiful specimen of the Nessus (*Amphion nessus*).

For the amateur collector the summer of 1915 was far from favourable. The bright days of May and June were nearly all marred by cold winds. This kept the sun-loving species inactive, and made your director's favourite field of collecting comparatively barren. This feature was specially noticeable in the second week of June and again after a spell of wet weather at the end of June. The early mornings were bright and promised well, but by noon quite a chill wind from the east had sprung up and the results of several all-day tramps were on the whole disappointing. In two years' residence in Peterborough it has been impossible for me to collect through the month of July, owing to work in Toronto. Next season this work will probably not be incumbent, and I have great hopes of watching more closely the insect visitors to blossoms during June and July in my new neighborhood. So far my observations have been chiefly confined to bark, sap, fungus and foliage.

Very early in May the tent caterpillars again made their appearance about Peterborough in large numbers. The city authorities set apart a small sum of money and had some men go round the residential streets within the limits, cutting off infected limbs and destroying some of the apple trees and wild plums on waste grounds and in hedges where the pest abounded. This work seemed fairly effective in saving shade trees about the city, but it did not strike at the root of the evil as Mr. Bowers points out. I had the curiosity one day to count the webs (very populous webs) beyond the limits on a stretch of lane about equal in length to two blocks of city street. They numbered over 100; choke-cherry, pin-cherry, wild plum, apple, and hawthorn, all affording food and shelter to myriads of both the forest and the apple tent caterpillar.

Early in May I paid a visit to the alder swamp between Peterborough and Best's where the varieties of Chrysomela reported last season had been found. These were all present once more, the differences from normal being apparently quite constant. In the middle of May where some cedar groves had been chopped down, I took several specimens of *Callidium aereum* on a cedar trunk. At the end of May I captured some interesting beetles in hawthorn blossom; these included *Cyrtophorus verrucosus, Molorchus bimaculatus, Callimoxys sanguinolentus, Acmæops proteus, Leptura capitata,* and *L. sex-maculata; Orsodachna atra;* and *Malachius æneus.* This last was new to me, though a single specimen was taken near Port Hope this year by Dr. Watson. It is very abundant in the neighborhood of Peterborough. The collection made by pupils at our collegiate, I notice, are rarely without it. Last season I saw fifteen or twenty at the end of June on the blossoming heads of meadow grass; and this season I captured over a hundred from a single hawthorn on Aylmer Street without apparently reducing the number of guests at the banquet. This beetle is interesting to the systematist. It is described by Le Conte and Horn as introduced from the West coast and is, moreover, *sui generis* in Eastern America. The family occupies a space between the Lampyridæ and the Cleridæ. I think the only other member of the family known to me is a *Collops,* a very pretty little beetle (also frequenting blossoms) that I have captured occasionally—once at Guelph, when I was out with Mr. Caesar.

In the first week of June at Jubilee Point on the north shore of Rice Lake I captured two specimens of an Agrilus, steel-blue, with white marginal marks on the metasternum and abdomen, feeding on hazel leaves; and on Spook Island

where I paddled over in the hopes of locating a colony of *Chrysomela scalaris*, var. *pnirsa*, I discovered nearly all the foliage on the island fretted into holes by millions of *Brachys ovata* on oak, *ærosa* on basswood and grapevine. About the middle of the month I spent a day at Hastings, and saw for the first time immense numbers of the larvæ of the Jumping Sumach beetle (*Blepharida rhois*); they were feeding on the fragrant or Canada Sumach. This shrub I have seen in three places only, on the north shore of the upper Rideau, in August, where the imago of this beetle was abundant; on the cliffs below the Whirlpool Rapids, Niagara, where no trace of either larva or imago could be seen; and here at last, June, 1915, where hibernated imagoes were occasional and larvæ in great abundance. The larva is one of the most disgusting sights in the insect world. It is covered with what appears to be liquid excrementitious matter. This is smeared so thickly over its surface as to give it a deformed lumpy appearance. The insect glistens with this slime much as the larva of the saw-fly, known as the Pear-tree Slug. Though the sumach grows, a low and upright shrub, in open pastures, and the insect feeds in broad daylight, exposed on the upper surface of the leaves, yet the fiercest rays of noontide sun seem to have no effect on its slimy coat; it neither evaporates nor cakes. Without imputing a fairly high aesthetic sense to insectivorous birds, we must suppose this creature to be just about as savoury a morsel as it looks; the soft, helpless, sluggish infant of a larva is just as immune as the hard-shelled, leaping and flying beetle.

On June 13th I captured a newly emerged specimen of the Elder-borer, *Desmocerus palliatus*, south-east of Peterborough. This is the earliest record I have made for the insect in our latitude; they became abundant in the last week of June. About the 10th of July I captured six in Niagara Glen and as late as the first week of August one in the neighborhood of Owen Sound. About the middle of June in some felled and decayed elms lying on the edge of a poplar swamp I found breeding several specimens of *Physocnemum brevilineum*. These were settling in the sunshine on the prostrate trunks, or sheltering from the east wind in crevices and under loose flakes of bark. It was there and then that I found the first specimen of the Elm Saperda (*Saperda tridentata*) I have ever taken on its food tree. As the net result of two visits to this collecting ground I will list the more interesting captures made:

Physocnemum brevilineum (elm)	25
Saperda tridentata (elm)	14
***Tetropium cinnamopterum* (white pine)	1
***Hoplosia nubila* (basswood)	1
Callidium antennatum (cedar)	1
Pachyta monticola (thimble-berry blossom)	6
Leptura proxima (thimble-berry blossom)	2
***L. chrysocoma* (thimble-berry blossom)	1
L. 6-maculata (thimble-berry blossom)	1
Rhagium lineatum (hemlock trunk)	1
Clerus thoracicus var. *rufiventris*	19
(wood piles)	abundant
Melanophila fulvoguttata (newly felled hemlock)	abundant
Anthaxia æneogaster (fleabane blossoms in hemlock swamp)	abundant
Xenorhipis brendeli (basswood stumps)	abundant

Besides these, seven or eight other species of Leptura were noted and ten other genera of cerambycid. In the latter part of June, larvæ, pupæ, and imagines of the very handsome Ladybird (*Anatis 15-punctata*) were found in great numbers on leaves of elder, ash, butternut, basswood and maple. About one-fifth of these were of the normal form, the rest were of the variety *mali*, in which the elytral spots are "eyed" with a narrow halo paler than the ground color. This mention of varieties recalls a point of interest in connection with an insect taken in 1914, but not identified by me till after our last meeting. The insect is the Staphylinid *Oxyporus*, but as my report is a long one I will omit the note, as I have done with similar notes on *Hoplosia nubila* and *Pogonocharus mixtus*. The note is mainly of systematic interest.

At the end of June I went down to Port Hope a few days before reporting for duty in Toronto. While there I visited a hardwood four miles north of the town, where axe and saw had been busy in the winter. Again I will save space by listing the more interesting captures made:

Neoclytus erythrocephalus (dead twigs of hawthorn and maple)	3
Arrhopalus fulminans (under bark, stump of butternut)	1
**Calloides nobilis* (under chip of oak)	1
**Centrodera decolorata* (maple stump)	1
Elaphidion villosum (oak stump)	1
**Pogonocharus mixtus* (pine trunk)	1
**Goes oculatus* (willow foliage)	1

The last beetle in this list was captured on the old home farm of Mr. John Hume. There is a swamp here just below a high ridge of land to the north, and where the willows are thick two streams flow out from the swamp, one about the size of a field drain, the other rather larger: the smaller flows south-east, the larger south-west. In the willows here I noticed a number of wasps flying to the stems. The stems proved to be covered with recent bore-holes, from which was exuding dark pulp. It was evidently the pungent smell of fermenting sap that had brought the wasps, and while I was investigating, several butterflies hovered or settled about the bores and two beetles (*Gaurotes cyanipennis*) were taken feeding at them. Presently I discovered a pair of weevils, with a large white patch near the apex of the elytra, resting on a stem a foot or two above the bores. It was *Cryptorhyncus lapathi* (as I have since learned from Mr. Caesar). I was unable to see any insect emerge from the tunnels, nor did I notice any ovipositing. Soon after, Dr. Watson came out with me and we captured over 20 of these curculios. Next day I had to go to Toronto as an associate examiner. This was about the 3rd of July. Dr. Watson visited the place about four times in the next five weeks and never failed to find several of these creatures on the willow. At Thanksgiving I visited the same place and also followed the larger stream for half a mile south-west. No insects were to be found on the trees, and though I took some infested stems home with me, I could find no trace of eggs. There were several larvæ, but I could not identify them for certain. One looked like the larva of *Saperda concolor*. The willow worst-bored appeared to be *Salix discolor*. Trees of *Salix nigra* seemed immune and also those of a species I could not identify—the leaves broad and not very long, rugose with veins on the upper side and downy beneath. The foliage was partly shrivelled in October and there seems to be much intergrading among the willows, which makes identification un-

satisfactory except in the blossoming season. The boring was worst at the base and seldom extended further up than eight or nine feet. Stems less than 2½ inches in diameter were seldom, if ever, touched. Those of 5 inches in diameter seemed the favorite resort, and occasionally stems eight and nine inches in diameter were badly bored, but not trees of greater thickness than this. The damage was observed over more than a mile of country between south and north, and half a mile between east and west. In the west area the willows were riddled with holes, and trees that had five or six stems growing out from the roots had (nearly all) lost some of these, either snapped off above by the wind or broken down by their own weight at the base. More than once in crossing the stream I broke off a thick stem by simply bearing on it with my hand. On returning to Peterborough after Thanksgiving I went through twenty or thirty collections of insects made by pupils of the school, and in one located a single specimen of the beetle. So far I have not found any damage to willows in our neighborhood.

While I was in Toronto (between July 3 and July 24) Dr. Watson captured a large number of *Urographis fasciata* on a felled oak as well as on a neighboring woodpile of the same material. On the log he saw also, but failed to capture, some specimens of *Neoclytus erythrocephalus*. They are extremely quick in their movements, especially during hot sunshine. Two days snatched from the holocaust of July, I managed to spend at Queenston and made a number of interesting captures between there and Niagara Glen, mostly about blossoms of New Jersey Tea. I have a list of these but will not trespass further on your time and patience.

**Toxotus cylindricollis* (foliage of hazel)	1
Plagionotus speciosus (foliage)	1
Oberea bimaculata (raspberry)	1
***Strangalia luteicornis* (New Jersey Tea)	3
**Leptura subhamata* (New Jersey Tea, all male)	4
***Leptura cordifera* (New Jersey Tea)	6
***Leptura* (sp. ? *dehiscens* New Jersey Tea)	2
Trichius, 2 species (flowers)	abundant
Macrobasis unicolor (vetch)	abundant
3 species of *Cryptocephalus* (foliage)	abundant
Eupogonius subarmatus (basswood)	abundant

Early in August I took another specimen of *Eup. subarmatus*, always on basswood; and throughout August in the Algonquin Park found *Leptura canadensis* common—none of them males.

On returning to Peterborough in September, I found the climbing nasturtium on our verandah-railing badly infested with *larvæ* of *Pieris rapæ*. In a few minutes I picked about 100 off the leaves over a space of about six feet. On each of the two following days I gathered almost as many. I suspect they came from a vacant field, nearly opposite, in which charlock has been allowed to grow. They were succeeded in October by black aphids from a neighbor's dahlias. These multiplied so on a thick stem that had twined about the verandah post that it resembled a ship's mast coiled round with a spiral of tarred rope.

Division No. 7, Niagara District—William A. Ross.

As Mr. Caesar in his report on "Insects of the Season in Ontario" will no doubt refer to most of the common pests found in the Niagara district, I shall confine my attention to a few insects which were of special interest to me.

Apple Aphids. The three species, *Aphis sorbi*, *Aphis pomi*, and *Aphis avenæ*, were again abundant. Some young apple orchards were very heavily infested with *A. pomi*, but in bearing orchards *A. sorbi* was, as usual, the chief depredator.

In connection with the summer hosts of *A. sorbi* it was found that the migrant forms readily colonized three species of Plantago—*P. lanceolata*, *P. major* and *P. rugelii*, and that as many as eleven generations of the aphid may develop on these weeds. Both in the insectary and in the fields *P. lanceolata*, common rib grass, appeared to be the favorite host.

The Pear Psylla (*Psylla pyricola*). At the Vineland Experimental Farm gratifying results in the control of this insect were obtained. In one experiment infested trees were sprayed, after the cluster buds had burst, with lime sulphur wash, testing 1,030 specific gravity. In a second experiment, of course with different trees, lime sulphur diluted to summer strength in tobacco water (1 lb. tobacco refuse in 2 gallons of water) was used and the application was made just after the blossoms had fallen. The results given by these two treatments can best be stated by quoting from notes made on May 22nd: "Exp. No. 1. Results good—very few nymphs are present on the trees. Exp. No. 2. Results practically 100 per cent. effective—only one living nymph found. Check. Psyllas are numerous on unsprayed trees."

Lesser Peach Tree Borer (*Aegeria pictipes*). Early in the season many complaints were received from fruit growers regarding a "worm" which bored into the trunk and large branches of peach trees and produced gumming. On looking into this matter it was found that in practically all cases the gumming was primarily caused not by the "worm" but by the peach tree canker fungus. The "worm," the lesser peach borer, was, however, very much in evidence in the cankered areas and by its work aggravated and greatly increased the wounds. I should mention here that I found the borer in all old cankers which I examined, and that I took as many as six larvæ from one injured area.

The adults of the lesser peach borer commenced to emerge towards the end of May and the maximum emergence appeared to take place during mid-July, judging by the large number of empty pupal skins found protruding from the trees at that time.

Cherry Aphis (*Myzus cerasi*). Last spring there was a serious outbreak of this plant louse on sweet cherries in different parts of the Niagara district. In a Vineland orchard, which I had under observation, the young shoots were injured so severely that by the latter part of July most of the tender foliage was dead. The fruit in this same orchard was small, ripened irregularly and much of it was covered with honey dew and honey dew fungus. In fact so much damage was done to the fruit that most of the crop was left on the trees.

Mr. Howard Curran, my assistant, sprayed two infested trees with whale oil soap, 1 lb. to 4 gallons of water, and destroyed in the neighborhood of 99 per cent. of the aphids.

The Raspberry Byturus (*Byturus unicolor*). This insect is rarely troublesome in Ontario. However, during May it was present in a large raspberry plantation near Jordan in sufficiently large numbers to give a great deal of anxiety to the grower. The beetle destroyed many of the flower buds by eating into them. It also fed on and skeletonized the tender foliage, especially the foliage near the flower buds.

The owner of the raspberry bushes sprayed them with arsenate of lead and

apparently got good results, because when I visited his place later on I found comparatively few beetles on the bushes.

THE RASPBERRY SAWFLY (*Monophadnoides rubi*). This pest was very troublesome last year, but I regret to say it was much more destructive this season. Two large raspberry plantations near Vineland were very badly infested and on many of the bushes all that was left of the foliage was the petioles and leaf ribs.

The raspberry sawfly is readily controlled by spraying with arsenate of lead, but as the insect is not regularly injurious the fruit grower seldom thinks of applying the remedy until it is too late.

THE PRIVET PLANT LOUSE (*Rhopalosiphum ligustri*). This greenish-yellow aphid was again very abundant on privet and as a result of its depredations several beautiful hedges were partially defoliated.

Last year I referred to this insect with some doubt as the European species *Rhopalosiphum ligustri*. However, there is no longer any question in regard to its identity, as my determination was confirmed by Prof. Theobald, of London University, England, who kindly examined some specimens which were sent to him.

Before coming to this meeting I had occasion to examine an infested privet hedge, and I was greatly interested to find three kinds of males present, viz.: winged, wingless and forms intermediate between alate and apterous. This would seem to suggest that the male of *R. ligustri* is in an unstable condition and that it is gradually changing from the primitive to the specialized form, i.e., from alate to apterous.

THE ASPARAGUS BEETLE PARASITE (*Tetrastichus asparagi*). Early in June this interesting chalcid, heretofore unrecorded in Canada, was found destroying the eggs of the asparagus beetle (*Crioceris asparagi* L.) at Vineland Station.

Tetrastichus has a very curious life history. The female by means of a sharp ovipositor pierces the egg of the asparagus beetle and deposits within it her own eggs (from three to nine in number according to dissections which I made). In due course, the beetle egg, its viability unaffected, hatches, and the grub grows to maturity. The chalcid eggs in the meantime hatch and the parasites apparently nourish themselves on the body fluids of their host without appreciably interfering with its development. The full-grown asparagus grub enters the soil and forms the pupal cell, but proceeds no further because at this stage it is wholly consumed by the chalcid larvæ. The parasites then pupate within their host's cell and later emerge as adults.

The adult *Tetrastichus* is a voracious feeder on the eggs of the asparagus beetle and in this capacity the insect is really of greater economic importance than in the role of a parasite. In support of this statement I may mention that early in June asparagus beetles and their eggs were exceedingly abundant on the asparagus plants at the Vineland Experimental Farm, but the hungry chalcids destroyed so many eggs that very few grubs hatched out—less than one per cent., I should say. Later on when the parasites were not so plentiful a larger percentage of the beetle eggs hatched.

In feeding the chalcid stands on the egg, plunges her ovipositor into it, and energetically works the ovipositor up and down usually for three or four minutes. She then steps back, applies her mouth parts to the puncture and feeds on the egg contents. If the first prodding does not render sufficient food available the operation may be repeated. In fact I noticed one chalcid attack an egg no less than four times.

There are apparently two broods of this insect in the Niagara district. Adults of what I took to be the first generation were very abundant during early June, but by June 28th they had all disappeared. Second brood "flies" emerged late in July and were found on the asparagus plants until the latter part of August. This generation was much smaller in number than the first.

REPORT OF THE BRITISH COLUMBIA ENTOMOLOGICAL SOCIETY.

Mr. Treherne: As Secretary of the British Columbia Entomological Society, a branch of this Society, I may say that our membership stands at about seventy at the present time. About thirty of these can be considered active members, those that are engaged in recording insects from different parts of the province, and who are anxious to receive information of a more technical character, such as is recorded in *The Canadian Entomologist.* The remainder are mostly farmers and fruitgrowers of a better type who are interested in the control of insect pests. We have an interesting development that occurred during the past year in the formation of sub-branches, Victoria and Vancouver. The Vancouver sub-branch are holding monthly meetings during the winter, turning in their reports to what they call the parent Society, that is to say, the Entomological Society of British Columbia. The membership has been affected on account of the war, several of our men having gone overseas, and our Society has decided to continue their payments out of their own funds. We have published up to date seven bulletins during the past three and one-half years. At the present time many recent members, members that are not particularly interested in the Society, are dropping out, and the result is that with those that are members we are getting on a more level basis in that we have men that are more keenly interested in the Society, and I think that in a year or two the Entomological Society of Ontario will find a very active, strong Society in the West.

Dr. Hewitt: The Society has listened with much interest to Mr. Treherne. We all know that the formation of the Branch out there is entirely due to Mr. Treherne's personal efforts and the support he has received from men like Mr. Wilson, who is with us to-day, Mr. Day, and others, and it is very satisfactory to think of the strong branch the Society has out there. We will now have the report of the Montreal Branch.

REPORT OF THE MONTREAL BRANCH.

The 42nd annual meeting of the Montreal Branch was held at 32 Springfield Ave., Westmount, on Saturday evening, May 15th, 1915.

The Secretary read the report of the Council as follows:

The Branch has held, during the season of 1914-15, nine monthly meetings, the average attendance being over six.

We record, with deep regret, the death of our late member Mr. Henry H. Lyman, who had been an active member since 1875, and had occupied all the executive offices of our Society at one time or another. By his will, his large and valuable collection of Lepidoptera and other insects, and his fine entomological library, are now housed in the Redpath Museum of McGill University. This is

now being carefully put into order and when funds become available it should rapidly become one of the most important insect collections in Canada, and of great assistance to students of insect life. By the terms of Mr. Lyman's will the President and Secretary of this Branch are desired to be associated with the Professor of Zoology of McGill University, as members of a committee to manage the bequest.

The papers read at the meetings during the year were as follows:

1. Annual Address of the President .... A. F. Winn.
2. Electrical Fuses Attacked by Larvæ of *Dermestes lardarius* Geo. A. Moore.
3. The American Tortoise Shell Butterfly, *Vanessa milberti* Godard .... A. F. Winn.
4. *Saldidae*, or Shore Bugs .... Geo. A. Moore.
5. Studies in the Genus *Phaeocyma* .... G. Chagnon.
6. The Geometrid Genus *Nyctobia* Hulst .... A. F. Winn.
7. The Coloration of Insects .... A. F. Winn.
8. The Coloration of Exotic Butterflies .... G. C. Clayson.
9. The Colors Seen in Hemiptera .... Geo. A. Moore.
10. Address on Annual Meeting .... Prof. Lochhead.
11. Illustrated Talk on "Work of Entomological Division ...... A. Gibson.
12. Notes on the Cause of the Blue Coloration of the Blue Lycænids .... H. M. Simms.
13. Report of the Annual Meeting of the Quebec Society for the Protection of Plants .... Geo. A. Moore.

Besides the regular papers read Mr. Winn exhibited the list of Quebec Diptera which had been compiled with the assistance of Mr. Beaulieu, and had been edited by Mr. Johnson of Boston.

Our January meeting was honored by a visit from Prof. Lochhead, of Macdonald College, with three students.

We also had a visit from Mr. Arthur Gibson, Assistant Dominion Entomologist, at our February meeting. He gave a lantern-illustrated talk upon the work being done at the different entomological laboratories in Canada.

At this latter meeting Mr. Simms illustrated the blue coloration of the Lycænids, by means of a spectroscope.

Our March meeting was made more interesting by a series of microscope slides being shown.

The report of the Treasurer showed a balance of $82.34 on hand.

Mr. H. M. Simms, one of our members, has enlisted for Overseas service in the great European war.

The following officers were elected for the ensuing year:

President .... A. F. Winn.
Vice-President .... G. Chagnon.
Secretary-Treasurer .... Geo. A. Moore.
Librarian .... G. Chagnon.
Council .... Messrs. G. A. Southee, G. H. Clayson, E. C. Barwick, H. M. Simms.

Geo. A. Moore,

Sec.-Treas.

REPORT OF THE TORONTO BRANCH.

The nineteenth annual meeting of the Toronto Branch was held in the Biological Building on Thursday, October 14th, 1915, the chair being occupied by the President, Dr. Cosens.

The minutes of the previous meeting having been read and approved, the report of the Council and financial report were presented and adopted.

Eight regular meetings, not including the annual meeting, were held during the season 1914-15, at which the average attendance remained about the same as in past years.

The following list comprises the papers read during the season:

Oct. 9. "Insect Aliens, Desirable and Otherwise," illustrated with specimens. Dr. A. Cosens.
Nov. 19. "A Trip to Point Pelee." Mr. C. W. Nash, Provincial Biologist.
Dec. 10. "Crickets," illustrated by specimens. Dr. E. M. Walker.
Jan. 14. "Some Entomological Notes in North Dakota," illustrated by specimens. Mr. F. J. Prewett.
Feb. 10. "Two Months in New Brunswick," with lantern illustrations. Mr. E. Horne Craigie.
Mar. 25. "Types of Neuroptera," illustrated by specimens. Dr. A. Cosens.
April 29. "Blood-sucking Flies," with lantern illustrations. Dr. E. M. Walker.

At the meeting held May 20th, Dr. Walker exhibited a collection of beetles intended for the Royal Ontario Museum; Mr. Hanniball, a living horned toad from Texas, and Dr. Cosens, galls and producers of the genus Rhodites.

A successful field meeting was held at Mount Dennis on May 29th.

During the season four new members had been elected, two had gone to the front, and one had resigned.

The financial report showed a balance on hand of $13.90.

A paper was read by Dr. Cosens upon "The Founding of the Science of Cecidology," after which the election of officers for the coming season took place.

The election resulted as follows:

President .... DR. E. M. WALKER.
Vice-President .... E. HORNE CRAIGIE.
Secretary-Treasurer .... S. LOGIER, 1244 St. Clair Ave., Toronto.
Librarian .... H. E. BICKNELL.
Council .... DR. A. COSENS, C. A. SNAZELLE, C. W. NASH, J. HANNIBALL.

Respectfully submitted,

E. HORNE CRAIGIE,

Secretary.

THE NOVA SCOTIA BRANCH.

THE PRESIDENT: We are very pleased to learn, as announced in the report of the Council, of the formation in Nova Scotia of an Entomological Society, which has become affiliated as a branch of the Ontario Entomological Society, and I should like to take this opportunity of congratulating Prof. Brittain and his associates in the energetic way in which he has collected together the scattered units who have entomological leanings in that Province. We shall be glad to hear from Prof. Brittain, if he has not a formal report, a few words in regard to the Society.

PROF. BRITTAIN: Though I did not prepare any formal report, I am pleased to be able to say that in July last we held an organization meeting and succeeded in forming a very flourishing branch of the Ontario Entomological Society.

We were fortunate enough to have the support of Dr. A. H. MacKay, Superintendent of Education; Mr. L. A. DeWolfe, Director of Rural Education; several of the provincial school inspectors and others. All of these men have shown the deepest interest in the work of the Society, and with their help we have been able to enlist the support of a large number of teachers throughout the Province, many of whom have already done some collecting and otherwise shown an interest in entomological work.

I have also had the heartiest assistance and encouragement from Mr. George E. Sanders, Field Officer of the Dominion Entomological Branch. In all these, together with the inspectors and ex-inspectors of the Dominion and Provincial Entomological Branches, we have a very good nucleus for the establishment of a strong and vigorous society.

At the present time we have a paid-up membership of forty-one members, and I confidently hope and expect that before the winter has passed, we will have doubled that number.

The President: I am sure the members have listened to this extempore report with very great pleasure. It is a matter of regret that while there used to be a branch in the City of Quebec, we have not had a branch there for many years, at least as long as I have been in this country, although we now have in the Province of Quebec the Society for the Protection of Plants from Insect Pests and Plant Diseases, which, in a way, takes the place of a Provincial Entomological Society. At the same time, I think there is room for greater activity in the Province of Quebec in the matter of entomology. We have a faithful friend in Mr. Chapais, who, I think, should try and work up the interest of the Entomological Society in the Province of Quebec. Before proceeding further I should mention that letters of regret have been received from the following people on account of their inability to attend the meeting: Mr. Grodge Davidson, Provincial Botanist of British Columbia; The Rev. Abbé Huard, Provincial Entomologist of Quebec; Prof. J. M. Aldrich; Prof. G. A. Dean; Dr. W. E. Britton, State Entomologist of Connecticut; and then, in addition, we had promises to be present from the following members of the Society and gentlemen who intended to be present: Dr. Felt, but he has had an urgent call to Long Island; Dr. Walker, who has been unable to come on account of his academic duties, and Dr. Bethune, who was not able to make the trip and who had lectures to attend to. Dr. Howard was to give our public address, but he is unable to come owing to the fact that he met with an accident. We also should have had with us Prof. Willing, Assistant Professor of Natural History at the University of Saskatchewan, but illness has prevented him from coming.

REPORT OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

I have the honor of presenting the following report of the work of the Ontario Entomological Society for the year 1914-15.

The past year was a very successful one. The active membership continues to increase, and the Society has now a relatively large number of trained workers engaged in the investigation of the many insect problems that arise yearly in every province. The presence of these new members has a stimulating influence on the general work of the Society. They are young men, mostly graduates of the agri-

cultural colleges, and filled with the enthusiasm of youth and eager to advance the interests of their profession. As a matter of fact the entomological interests of the Dominion are now, to a large extent, in their keeping.

Another feature of recent entomological work is the appearance of an increasing amount of investigation that might fairly be classed as high grade. This result may be attributed to the fact that our younger entomologists have the advantages of a scientific training and are thus able to undertake problems beyond the power of their predecessors.

Much of the credit for the vigorous condition of the Society must be assigned to its active President, Dr. C. G. Hewitt, Dominion Entomologist, who presided most worthily at the fifty-first annual meeting held in Toronto on the 5th and 6th of November last. This meeting was well attended, and many valuable papers were presented. Considerable discussion took place on various subjects of importance, particularly on the outbreak of the Army-worm in Canada in 1914.

Following is a list of the chief papers and addresses:

"Applied Entomology in Canada: Its Rise and Progress," the address of the President, Dr. C. G. Hewitt.
"The Habits of Spiders" (illustrated), by Prof. J. H. Comstock, Cornell University.
"Jean Henri Fabre, the French Entomologist," by Prof. W. Lochhead, Macdonald College, P.Q.
"Insects of the Season," by Prof. L. Cæsar, A. Gibson, W. Lochhead, A. Cosens, J. A. Morris, W. A. Ross, C. E. Grant, and C. E. Petch.
"The 1914 Outbreak of the Army Worm in Canada," by A. Gibson.
"The Army Worm in Ontario in 1914," by A. W. Baker, O.A.C.
"Mountains and Hills," by Dr. T. W. Fyles, Ottawa.
"Experiments with Poisoned Bran Baits for Locust Control," by A. Gibson, Ottawa.
"An Imported Red Spider Attacking Fruit Trees," by Prof. L. Caesar.
"Cherry Fruit Flies," by Prof. L. Caesar.
"Control of Forest and Shade Tree Insects of the Farm," by J. M. Swaine, Ottawa.
"Variation in the Hedgehog Caterpillar," by A. Gibson.

The Canadian Entomologist, the monthly journal of the Society, continues to maintain its high reputation and its wide circulation in spite of the increased subscription price. The 46th volume, completed in December last, is the largest and most fully illustrated that has yet been published.

During the year 1914 and since the last meeting of the Royal Society, the Ontario Entomological Society lost two of its best known members. Mr. H. H. Lyman perished in the disaster to the "Empress of Ireland" on the 29th of May—a few days after he had presented his report as delegate of this Society. Dr. William Saunders, ex-Director of the Dominion Experimental Farms and one of the charter members of this Society, died at his home in London on Sept. 13th. In his Presidential Address at the Annual Meeting in Toronto, Dr. Hewitt spoke very feelingly of the loss of these two highly esteemed members and ex-presidents of our Society, and paid a high tribute to their memories. Besides, our worthy and revered member, Rev. Dr. Bethune, who knew both very intimately for many years, has written notes of high appreciation in the 45th Annual Report.

W. Lochhead, *Delegate.*

INSECTS OF THE SEASON IN ONTARIO.

L. Caesar, Ontario Agricultural College, Guelph.

The past season with its abnormal amount of rainfall has been much more favorable for the development of plant diseases, both fungous and bacterial, than of insect pests.

Codling Moth (*Carpocapsa pomonella*). The most interesting thing about the Codling Moth was that in the Niagara district, where the amount of injury done by the second brood is usually very much greater than by the first, this year for the first time in my experience things were just reversed, the second brood being remarkably small, though the first brood was about as abundant as usual. Probably the excessive moisture was the chief reason for this, though other factors may also have been at work.

Plum Curculio (*Conotrachelus nenuphar*). This insect also was apparently less abundant than usual, although the fruit in neglected apple orchards suffered a great deal of injury both from spring and fall attacks. On some trees nearly every apple was deformed.

San José Scale (*Aspidiotus perniciosus*). The season of 1914 with its dry summer and long open fall was remarkably favorable for the increase of San José Scale. This was not true in 1915, for this year, so far as my observation enables me to judge, the increase has been less rapid than usual. This spring was also favorable for good results from careful spraying. With a single application we were able to destroy almost every scale in an old orchard that would otherwise have been nearly all dead by now. Lime-sulphur, strength 1.035, was used on one part of the orchard; Soluble sulphur, strength 12½ lbs. to 40 imperial gallons, on another part, and Scalecide 1 to 15 on a third. All were about equally satisfactory this year.

Blister Mite (*Eriophyes pyri*). For some unexplained reason the increase of Blister Mite, even in unsprayed orchards, the last two or three years has been very slight; in fact some trees seem to have fewer leaves infested than three years ago.

Leaf-Rollers [*Tortrix* (*Cacœcia*) *rosaceana*, *T. argyrospila* and *T. semiferana*]. (See p. 163.)

Capsids Attacking Apples (*Neurocolpus nubilus*, *Paracalocoris colon*, *Lygidea mendax* and *Heterocordylus malinus*). All four of these Capsids were found on apple trees but not all in any one orchard. *Lygidea mendax* was found in the greatest number of orchards, but *Neurocolpus nubilus* has apparently been the most destructive. It was sometimes found with *Lygidea mendax*, but in other orchards was the only species present. *Heterocordylus malinus* apparently did almost no harm and was much more common on hawthorns than on apples. *Paracalocoris colon* was also scarce. *Lygus invitus* is abundant in the Province but has not yet been found attacking apples or pears. Mr. Crawford's paper gives an account of our work on *Neurocolpus nubilus*.

Tent-Caterpillars (*Malacosoma americana* and *M. disstria*). These caterpillars still destructive in the eastern half of the Province, though Mr. E. P. Bradt, the district representative at Morrisburg, informs me that a large percentage, apparently 50 per cent., of the eggs failed to hatch and fully 50 per cent. of the caterpillars died before reaching maturity. There has been a gradual decrease the last two years in the numbers of both species down east, but this is not true of the western part of the Province, into which they are gradually spreading.

M. americana is now very abundant, at least as far west as St. Thomas. It has not yet, however, so far as I could see, become numerous in the extreme western counties. Around Guelph there are many egg masses this year, and, therefore, prospects for a severe infestation next year. *M. disstria* west of Toronto does not seem to be nearly so abundant as *M. americana.*

Fall Canker-worm (*Alsophila pometaria*). Throughout a considerable stretch of territory from Grimsby west, including Hamilton and Dundas, the Fall Canker-worm is very numerous and destructive. It is also very abundant in some forests in Norfolk County where the American elms, basswood, wild cherry, blue beech, birch and oaks were either partly or entirely defoliated. Elms suffered most. Maples were not so severely attacked as the other trees mentioned. Several other kinds of loopers were also prevalent on these trees, but not in nearly so large numbers as the Fall Canker-worm.

Pear Psylla (*Psylla pyricola*). Early in the season it looked as if pears were going to be much infested by this insect, as adults and eggs were abundant. However, the cold weather of May destroyed all but a very few. By autumn a few orchards were again badly infested.

Aphids. On apple trees there were many aphids this spring up to a few days before the blossoms were ready to burst. They then almost completely disappeared in all the orchards that I had an opportunity to examine, so that apple trees suffered very little from any of the leaf and fruit infesting aphids.

The Woolly Aphis (*Schizoneura lanigera*) in some districts was abundant, especially on young shoots in late summer and autumn. On cherry trees at Guelph the Black Aphis (*Myzus cerasi*) was very conspicuous and much more numerous than for many years past. It was also very troublesome in the Niagara district.

When moderately early peas were just beginning to bloom in Norfolk County hundreds of acres of them grown for the canning factories were threatened with destruction through the abundance of the Pea Aphis (*Macrosiphum pisi*) on the blossoms and new growth. Fortunately there came several days of very hot weather with occasional heavy downpours of rain and almost all the aphids disappeared. Sufficient damage, however, had been done to lessen the yield considerably and in some fields almost to destroy the crop. The Pea Aphis has done more damage the last few years in Ontario than it formerly did.

Peach Borer (*Sanninoidea exitiosa*). Many complaints have been coming in of injuries from this borer, particularly from those districts where peaches have only recently been grown to any appreciable extent. I suspected at first that the gum oozing out of the trunks of the trees as the result of winter injury was being mistaken for the work of the borer, but my observations this year in Norfolk County showed that such was not necessarily the case, as nearly every tree in some orchards was attacked by from 1 to 20 or more borers. We have done some preliminary work on the control of this pest, and in this connection have also worked out fairly well its life history for this Province. It will be interesting to some to learn that adults appeared in Norfolk County as early as July 15th and continued up into September. One female in Niagara was seen on September 11th.

Lesser Peach Borer (*Aegeria pictipes*). The numerous cankers on peach trees in many orchards in the Niagara district have given ideal conditions for the increase of this insect, so that it is to-day very prevalent in that district. Control measures under the circumstances are not easy.

Rose Chafer (*Macrodactylus subspinosus*). Near Fonthill several vineyards had almost every grape cluster destroyed by this pest. I visited the district as soon as informed of the trouble, but it was then too late to do anything as the

beetles had already begun to disappear. Several acres of waste sandy land lying alongside the infested vineyards showed ideal conditions for bringing about just such an outbreak.

IMPORTED RED SPIDER (*Tetranychus pilosus*). This spider was found as far east this year as Trenton. It continues to do considerable injury, especially to European plums. Some trees, however, that were badly infested last year were only lightly attacked this year. Moreover, in some apple orchards trees heavily infested just before bloom were comparatively lightly infested a couple of weeks later. It is very probable that weather conditions have a very important part in the control of this pest as of so many others.

GRAPE-VINE FLEA-BEETLE (*Haltica chalybea*). There were again many complaints of injury from this beetle, especially in the Niagara district.

GRAPE LEAF-HOPPER (*Typhlocyba comes*). This insect was very abundant in the Niagara district. Red grapes were, so far as I observed, much worse attacked than blue. The foliage on many of the former in September was so brown from injuries that one would expect the fruit at picking time to be inferior in quality. I have had no opportunity to test whether this was so.

RASPBERRY SAW-FLY (*Monophadnus rubi*). This raspberry pest is very widespread in the Province and has the last few years been doing more damage than usual. One large raspberry plantation near Vineland was almost completely defoliated by it this year.

IMPORTED CURRANT-BORER (*Aegeria tipuliformis*). Almost every currant plantation is infested by this borer. In some cases a very large number of the canes are found to be attacked.

GLASSY CUTWORM (*Hadena devastatrix*). Last autumn at our annual meeting I reported that some fields of wheat had been badly injured by this cutworm. The caterpillars in November last varied in length from about ½ to 1 inch; hence we expected these over-wintering caterpillars, where numerous, to do much damage. As soon as growth began in spring reports started to come in of fields of wheat and barley being attacked. Several fields of wheat were almost ruined by the severity of the attacks. A few Army-worms, but only a very few, were found among the cutworms. As the Glassy Cutworm works under the surface of the soil farmers were advised to use the poisoned bran, harrowing it into the soil in the evening. I did not receive any reliable accounts of the degree of success obtained. About the usual number of reports of damage by other kinds of cutworms here and there throughout the Province were received.

STRAWBERRY WEEVIL (*Anthonomus signatus*). A few more complaints than usual were sent in of injuries from these insects.

IMPORTED ONION MAGGOT (*Pegomyia ceparum*). It is worth recording that in the great onion marshes of Kent County I could scarcely find a root maggot when visiting the district this summer. Growers tell me they are never troubled by it. This is strange, because onions have been grown on these marshes for at least fifteen years, and, as the Onion Maggot is a very troublesome pest in many parts of the Province, one would expect it to do even more damage in the marshes where onions are grown on a larger scale than anywhere else in Ontario.

SLUGS. In Oxford County the district representative stated that Slugs were so abundant this spring that some farmers claimed they were destroying the corn just as it was coming or had come through the ground.

MILLIPEDES. Last year, but more especially this year, Millipedes were very abundant and several correspondents asked for methods of destroying them. Some work was done in testing different substances. Of these tobacco seemed the most

satisfactory, although it was not a complete success. The Millipedes are repelled by it and, where they come into close contact with a moderately strong solution, are slowly killed. Dusting tobacco refuse thickly over the garden where they are troublesome and then watering it well with the hose once or twice a day for a few days seems about the best method, and the least dangerous to the plants. It is probable that placing decaying fruits or other decaying vegetable matter here and there in little heaps among infested plants and then pouring scalding water over such traps daily would gradually do a great deal to free the garden of the Millipedes. They are very fond of collecting under such decaying refuse and roam around in the dark so freely that they would be very likely to find the baits.

Spittle Bugs (*Cercopidæ*). This seems to have been a remarkably favorable year for the multiplication of Spittle Bugs. Complaints of the great numbers of froth masses on the grass came in from Clarksburg, Mount Forest, Ridgeway, Thornton, Oakville and several other districts. A few pasture fields near Oakville were so badly infested that the farmers, fearing injury to stock if they fed on the infested grass, mowed the pastures and destroyed the cut grass.

A Sarcophagid Attacking the Forest Tent-Caterpillar (*Sarcophaga aldrichia* Parker). In 1914, while engaged in some investigation work in the County of Dundas, I observed that many of the pupæ of the Forest Tent Caterpillar were parasitized by what I considered to be the larvæ of a Tachinid Fly. On further examination at Mountain, Kempton and Morrisburg I estimated that close to 90 per cent. of all the pupæ contained what seemed to be this same larva. About 30 of the cocoons were gathered and brought to Guelph, though it was nearly two weeks before I reached there. On my arrival the cocoons were all transferred to a pint jar, in the bottom of which an inch or so of sand was first placed. The jar then was covered with cheesecloth. In May, 1915, I happened to glance at the jar and to my surprise found seven dead and one living Sarcophagid. These Dr. J. M. Aldrich kindly identified for me. He states "The species is one which Mr. R. R. Parker now has in manuscript as *Sarcophaga aldrichia*, n.sp. His article is completed and, I think, is deposited with the Boston Society of Natural History for publication, but I am not quite sure on that point. I will send him a quotation from your letter if you do not mind, as it indicates a considerable economic importance for the species which is widespread, occurring in the Puget Sound region."

If I am correct in my opinion that the death of the pupæ was due to the larva of this insect and not to disease, we have here a very good example of what seems to have been only comparatively recently fully admitted, namely, the true parasitic habits of some Sarcophagids.

Phorocera Doryphoræ. In June Prof. T. D. Jarvis called the attention of my assistant, Mr. A. H. Cowan, to the white eggs on the back of Colorado potato beetles at Grimsby. Mr. Cowan reported to me and on my suggestion reared a few adults and captured a few more that were attempting to lay eggs. Dr. Aldrich identified all these as *Phorocera doryphoræ*, a parasite that, as he says, has been bred repeatedly from this host.

Mr. Cowan made the following observations: "Eggs begin to be laid in June. At first they seem to be laid only on adult beetles, but later to some extent on the slugs. From June 18th to July 13th eggs were found mostly on the beetles, 1/3 to 1/2 of the beetles being affected. Early in July some were found on larvæ also, but always on nearly full-grown larvæ. The total time from egg to adult fly would appear to be about one month. On September 15th the eggs and adult flies were again found at Vineland."

At Simcoe I observed on several occasions what was probably this same Tachinid attempting to lay eggs on full-grown larvæ of Colorado potato beetle.

Poplar Sawfly (*Trichiocampus viminalis,* Fallen (?)). On September 28th the Parks Commissioner of Toronto sent me a few Sawfly larvæ that were attacking the foliage of Carolina poplar in the City and asked for the name of the insect and the method of control. On looking over the list of insects given by Dr. Felt in the New York Museum Memoir 8 as attacking poplars I found that the description given there of the larvæ of *Trichiocampus viminalis,* Fallen, agreed very closely with the larvæ I had received. The latter were, when full grown, nearly one inch in length, orange-yellow in color, though some had a decided greenish tint. The head and caudal plates were black, and on each side of the body were two rows of distinct black spots, the spots in the upper or subdorsal row being three or four times as large as those in the lower or stigmatal row. On the back and sides were numerous white hairs arising in thin tufts from numerous tubercular-like areas on each segment. These hairs were not more than 1/4 as long as the width of the body.

I wrote to the owner of the infested trees for further information on the habits of the insect. The following extract is taken from his reply:

"The caterpillars were green at first, changing to yellow as they grew larger, apparently being full grown by the time they had eaten a full sized leaf. They were all side by side on the under side of the leaf tight together, eating from the edge away from the stalk towards it. That is to say, their heads were away from the stalk and they kept getting towards the stalk as the leaf was eaten away. Some of them grew faster than others, or seemed to, and as the leaf narrowed down they dropped off, thus leaving the smaller ones to finish the leaf. When I first noticed them they were small and green, and I should say there were about twenty on a leaf. It was full on the outside edge with all lying the same way, heads from the stalk of the leaf, the middle ones parallel with the thick membrane of the leaf, that is the continuation of the stalk. After dropping off the leaf they crawled all over the board fence and up the side of the house everywhere off the ground looking for holes in the fence. They went into every hole or crack they could find. The fence was covered with them. Into some overalls that were hanging on the line they got and when found were in a cocoon. Every leaf that they were on was completely eaten except the stalk, and the continuation of it right to the point. I notice that it is not a leaf here and there, as all the leaves on some branches are eaten and others not touched. I should say they have been on about 1-20th of the branches of the trees and eaten them. As there are six trees about 35 feet high, you may guess the number of them. I can only say there were thousands. I killed thousands myself with a broom on the fence."

THE IMPORTED WILLOW AND POPLAR BORER OR CURCULIO.

(*Cryptorhynchus lapathi* L.).

L. Caesar, Ontario Agricultural College, Guelph.

About the middle of August I was requested to investigate the injury done by a borer to willows and poplars in the eastern part of Toronto Island. I visited the district on August 21st and again September 8th. On the latter occasion

J. E. Howitt, Professor of Botany, kindly accompanied me to assist in the identification of the species of willows and poplars that were attacked and also of those that were immune.

The insect in question was, as suspected, the Imported Willow and Poplar Borer or Curculio. The total damage done on the island was not large but was sufficient to convince the Superintendent of Parks that if the insect were to spread throughout the island and attack all kinds of willows and poplars, it would destroy the beauty and attractiveness of Toronto's favorite summer resort. One can easily understand why he should feel alarmed when we consider that about 90 per cent. of the trees on this island consist of willows and poplars, because these are the chief kinds that will thrive in its light, sandy, moist soil.

My observations showed me that before I could suggest the right means of control it would be necessary to know two things: first, at what time infested trees should be cut down and burned to destroy the maximum number of the

Willow Curculio: two adults, a pupa and full-grown larva. (All about natural size.)

insects; second, what species or varieties of willow and poplar, if any, were exempt from attack. If the latter species were known they could henceforth be substituted for the kinds subject to attack.

On looking over the literature on this insect I found that to satisfy myself on these points I should have to devote whatever time could be spared this autumn to finding out whether the borer differed in Ontario in any important respects from the accounts given by Kirkland, Jack, Webster, Chittenden, Felt and others. The following are the results of my investigations:

Length of Time the Beetle has been in the Province and Present Distribution.

This beetle, which is known to be a native of Europe and of parts of Asia, and which is supposed to have been imported into the United States about the year 1880, was not, so far as I have been able to discover, found in Ontario until the year 1906. That year Mr. Cosens took it at High Park, Toronto, and Prof. E. J. Zavitz at Ridgeway and Beamsville. These discoveries in three widely separated localities lead me to believe that it must have been in the Province

several years earlier. Up to the present time I have records of its presence at the following additional places: St. Catharines, Grimsby Beach, Grimsby, Winona, Fruitland, Guelph, Elmira, Willow Grove near London, Toronto Island, Port Hope, Trenton, Hillier (Prince Edward County) and Montreal (Quebec).

There has been very little opportunity to examine other parts of the Province, but the above localities show a very wide distribution throughout the Province, especially along the great waterway on the south. It is apparently, however, not yet all over the Province, because I have been in several localities where there seemed to be no evidence of its work, and Dr. E. M. Walker tells me that he has not seen any evidence of injury from it at Lake Simcoe. Montreal, near which Mr. Swaine reports its presence, seems to be the only place it has been seen in Canada east of the Province of Ontario, though very likely it is present in several localities but has not been noticed.

Host Plants.

In Europe this insect attacks several species of willows and poplars and also a few species of birches and alders, including our common alder (*Alnus incana*).

In the United States a perusal of the writings of Jack, Kirkland, Webster, Chittenden, and Felt, show that scarcely any species or variety of poplar or willow, whether native or imported, is entirely exempt and that the birches (*Betula pumila* and *B. nigra*) are also occasionally attacked. I do not remember seeing any definite record of its having been found in alders.

In Ontario I have devoted every opportunity I could get to discovering the host plants and the degree of infestation of each. Prof. Howitt has assisted me greatly in determining the species whenever I was in doubt. I find that the insect prefers Balm of Gilead (*Populus candicans*) and Balsam Poplar (*Populus balsamifera*) to any other variety of poplar, but that it is sometimes quite abundant in Carolina Poplars, especially where the above species are not present. At Guelph the Balm of Gilead is severely infested in a small clump of poplars on the College grounds, but the other poplars in this clump, consisting of the Carolina, White, Large-toothed and Lombardy species, are untouched. By the edges of a woods not far away from the College the Balsam Poplars are much injured by the pest, but the American Aspens alongside them are uninjured. The same was true of the aspens near infested Scrub Willows in the swamps.

Of the willows the worst infested are our native Scrub Willows found so abundantly along streams. A tree willow, whose species could not be determined at this season of the year, was also severely attacked. This willow grows 25 feet or more in height, has not so large spreading branches as the Golden or White Willow (*Salix alba*) or the Crack Willow (*Salix fragilis*) but has much more slender and drooping branchlets and smaller, more delicate leaves. It is evidently a native species. One ornamental Weeping Willow in a lawn at Winona was killed by this borer last year. It was the dark-bark type of Weeping Willow, apparently an imported tree. Of the other willows we have not seen more than a very light infestation on the Crack Willow, and the White Willow has been entirely uninjured, as also the Glossy Willow (*Salix lucida*). There are not many Babylonian Willows to be found, but so far they too have been uninjured wherever examined.

Comparing what we have observed in Ontario with what has been written of the host plants in the United States, it seems quite clear that Balm of Gilead, Balsam Poplar, and our native Scrub Willows, along with one or two native

tree willows, are the favorite food plants. Next to these would appear to be the Carolina Poplar (*Populus deltoides*).

No alders were found infested even when in the midst of infested scrub willows. Birches have also appeared to be exempt in Ontario.

Nature of the Injury.

The photographs show sufficiently well the sort of injury done. It is all caused by the larvæ. These work both in the sapwood and heartwood in older trees and in the heartwood of very small trees. The borers seem to prefer the base of the smaller trees, but they are found on larger trees as high as 15 feet or

Cross section of a young poplar and of a larger willow tree, near the base, showing the work of the borers. (About natural size.)

Longitudinal section of a poplar tree, showing tunnels made by the larvae. (Slightly reduced.)

more. In old trees with rough bark they usually work in the lower branches instead of in the base of the trunk. Often there are so many tunnels, especially towards the base of the tree, that it is weakened and easily broken down by a strong wind. It is quite common to see Scrub Willows killed and also small poplars. The swellings on the bark of poplars where the larvæ have entered, and also the exit holes, cause the trees to look unsightly, and these, along with the castings around them composed of small tissues of wood from the tunnels, dust and fæces, easily reveal the presence of the insects. The total number of trees destroyed in the Province must be large, but the Scrub Willows are of very little value and, though the Balm of Gilead and Balsam Poplars are of much more importance, they can scarcely rank among our valuable trees. Fortunately not many Carolina Poplars seem to have been killed yet. These are good shade and landscape trees and their loss would be deplorable.

Life History.

Adults.—The adult is a snout beetle, stout, about one-quarter inch long, black, with the body and legs mottled with light pinkish or grayish white scales. These scales are so abundant on the sides of the prothorax and also on the anal third of the wings as to cause these parts to be pale pink or white. The upper surface of the body is rough, being coarsely and deeply punctured, and having longitudinal furrows on the elytra. The rough appearance is increased by the presence of a few tufts of black scales scattered here and there over the thorax and elytra.

I do not know how early the adults begin to appear. In willows at St. Catharines examined about June 20th, 1914, the larvæ seemed full grown but no pupæ were seen. As Kirkland estimates the pupal stage at about 18 days, it is probable that adults would have been found last year on these trees early in July. Mr. F. Morris found many adults on willows near Port Hope the first week in July, 1915. I have captured a few in August in previous years. By September 8th, 1915, by far the majority seemed to have emerged at Toronto Island but they still continued to appear this year all the first half of October, the weather being warm. An examination on October 23rd showed a few live adults still in their burrows in poplars, also some pupæ that looked healthy and four larvæ, but three of the latter were dead. The fourth looked healthy but, when handled, did not move, so may also have been dead. In all the accounts I have read it seems to be assumed that very few adults are to be seen in the spring. Kirkland found one which he remarked was "probably an overwintered specimen." But the adults in May are not nearly so few in number in Ontario as one would expect from the different accounts of the insect given. Three of my nursery inspectors each captured several specimens and saw others this last May on poplars and willows in the nursery rows. There were a few also on apple trees in adjoining rows. It is not known whether these passed the winter in the trees as adults, pupæ or larvæ, or whether they emerged in autumn and wintered over under shelter. The important point is that there was a considerable number of adults found at that time of the year, indicating that many others also were probably present. The adults in autumn hide on cold days but appear on the trees when the weather is warm. They feed on the juices exuding from injuries at the points of exit, also upon the young twigs, where they seem to prefer the neighborhood of leaf scars, in which the small feeding punctures are often seen. These punctures, however, may also be found in various other parts of the tree and sometimes even on the bark of dead fallen branches. In breeding cages I fed

them on pieces of ripe apples and peaches, both of which they relished greatly. I do not know the length of life of these autumn adults, but five specimens caught in September were still alive almost a month later when I removed them from the cages. The last adults were seen in the open on October 11th. One found then was ovipositing.

Eggs.—Oviposition probably begins early in August, but with the very limited time at my disposal the first adult I could find doing this was on September 29th. After that date I saw several both in the cages and outside. It is very probable the beetles found in May oviposit in spring, as in Europe, eggs are laid both in autumn and in spring. The eggs are laid, as one would expect, at such places on the tree as we find the injuries later. Sometimes this may be at the base of a bud or small branch, but on the Balm of Gilead trees under observation and also in the cages it was just as commonly on the internodes, sometimes where there was a small rupture in the bark, sometimes where there was no rupture. About one hundred egg punctures in all were observed and several ovipositions. Before laying the egg the female eats a small hole, usually easily visible to the eye, through the bark to the full depth of her proboscis; at the bottom of this she makes one, two or three cavities. Where there are more than one they are a little distance apart from each other. Then she turns around, inserts her protruded ovipositor into the hole and lays an egg in each cavity. The making of the hole and laying of the egg is a slow process. I observed one which had already been at work some time when noticed and from the time she was first seen until the eggs were laid was a little over thirty minutes. One female was observed after laying the egg to turn around and insert her beak into the hole many times as if putting in small particles of bark. The eggs are pale translucent whitish, oval, about 1.5 mm. long and a little more than half as wide as long. Each female probably lays many eggs. One about to oviposit was dissected and only three mature eggs were found in the ovaries, all the others being much smaller.

It is hard to say how long it takes the eggs to hatch. As stated the first oviposition was observed on September 29th, but an examination from time to time of egg punctures at Guelph revealed no larva until October 7th. On October 25th, fourteen egg punctures on a Balm of Gilead were examined and in five of these sound unhatched eggs were seen, in five others tiny living larvæ, and in the remaining four hatched eggs but no larvæ. All previous examinations showed more unhatched eggs than larvæ on all trees.

Larvæ.—The freshly hatched larva is white, curved, and has a brown head. Full-grown larvæ are, as shown in the photograph, stout, about half an inch long, white, curved and have a brown head and no legs.

The young larvæ found were in every case very near where the eggs had been deposited, and had not eaten their way through the bark. They appeared to be settled down comfortably for the winter. Only in one case was there any evidence of a larva having reached the cambium, and that one was doubtful.

The discovery of so large a percentage of healthy eggs along with these tiny larvæ would suggest that the winter is probably passed in the egg stage as well as the larval. We saw above that it is apparently passed also either in the adult or pupal stage or both, with a slight possibility of there being some full-grown larvæ too remaining over in the burrows.

A study of the burrows shows that in spring the larvæ work obliquely into the sapwood, throwing out many castings at first as they do so. When they have gone in some depth the entrance appears to become closed, at least in poplars,

by a callous growth, referred to above. Once in the wood the burrows run nearly straight. The total length of a burrow is from 2½ to 4 inches. In spring the larvæ clearly grow very rapidly, as by the end of June they are about full grown in many cases. When this stage is reached they evidently turn back in their tunnels and enlarge them either to the place of entrance or else to some more convenient exit. They then return to the far end of the burrow, make a little chamber for pupating, then with head toward the exit change into a white pupa. The adult works its way out through the tunnel enlarged by the larva.

Means of Distribution.

The insects have been widely distributed by shipping out poplars and willows from infested nurseries. The tiny larvæ or eggs in these in the spring would easily escape notice. In addition to this means there seems no doubt that the adults fly about from place to place. They have large under wings well adapted for this purpose. Flight is probably late in the evening or at night, as I have never seen an adult fly when observing them during the day.

Methods of Control.

In most cases no effort will be made to control or prevent injury from the pest, but in parks like Toronto Island, control measures are very necessary. It was my intention to suggest that all infested trees be cut down in the winter and burned early in spring, but since learning from my inspectors of the discovery of a considerable number of adults in May which very probably lays eggs, I have thought it wise to suggest that the cutting down and burning should not be done until the first or second week in June, so that all the insects might then be caught in the larval stage. This should lessen the numbers of the insect greatly. Then to avoid future loss in these places I think that the willows most exempt from attack, viz.: the White Willow (*Salix alba*), one of our largest and best willows, and possibly the Glossy Willow (*Salix lucida*) should be planted instead of those removed. Also White Poplar and Aspen Poplar might be substituted for the Balm of Gilead, Balsam Poplar, and even for Carolina Poplar. Of course if Soft Maples, Dogwoods or other suitable trees or shrubs will thrive in these places, they would be preferable to any of the above. I should be very pleased to have further suggestions from anyone present.

The President: I am sure we have all listened with much pleasure to Mr. Caesar's two excellent papers. They are now open for discussion. We are pleased to see with us to-day Professor Zavitz, the Provincial Forester of Ontario, and he has no doubt something interesting to say regarding the papers just read.

Prof. E. J. Zavitz: Mr. Chairman, I came here to obtain information, and this beetle to which Professor Caesar has been referring is naturally of interest to foresters. I first saw it in the Niagara District near Ridgeway, working in the scrub willows. This season, in visiting that district early in the summer (it is a favorite collecting ground) I found that these willows had been entirely killed.

I think the chief danger from this insect is to our Carolina Poplar (*Populus deltoides* Marsh) which, to my mind, is the most important poplar from the foresters' standpoint. We were beginning to think that the Carolina poplar would be a very important tree in sand planting and in fact we are using considerable numbers in Norfolk County. I regret to find that this insect is working in that tree. Apart from the willow holts or basket willows, the damage to willows will be small. We use the other willows to a very small extent in forest planting.

The chief injury from the standpoint of the forester will likely be to the poplars and especially the Carolina Poplar.

The President: Perhaps Mr. Swaine would like to make a few remarks in this connection.

Mr. Swaine: Mr. Chairman, I have had very little opportunity to study this beetle in Canada. Some years ago in Ithaca it was very common in the basket willow in the plantations there and did considerable damage. In Canada I have found it only near Ste. Anne's and it was there in the common scrub willows and not very abundant. I have not had it sent in in the last three or four years in any numbers from any part of Canada except Ontario and southern Quebec, and very few reports have been received. Mr. Caesar's account was very interesting, indeed; the life-history is just as I remember it on the different occasions I have studied it, and the control measures usually given are not very effective; it is a very difficult matter to control this beetle. On the smaller willows no special effort to save any particular tree is worth while and the destruction of the infested trees is perhaps the only effective method. Only a few of the willows that are affected are worth saving.

Mr. Winn: Professor Caesar mentions the keeping of the beetle alive on apple or peach. I may say he very kindly sent me ten specimens of the beetle to show what it looked like in order that I might recognize it if I ever found it alive. After a couple of days I turned the specimens out on a blotting pad and pinned two or three, then noticed that instead of there being ten there were only nine. The tenth was still alive and had crawled away. This I secured and placed in a tin box and after again taking it out three weeks later, apparently dead, it recovered. This shows how long the insect can live without food being given it, and how dangerous the insect might be when capable of living through a like shortage under natural conditions.

Prof. Caesar: One of the points that I would like very much to get information on is whether any person has found the adults of this beetle in the spring. It seems to be taken for granted in the U. S. literature on this pest that it does not pass the winter as an adult, and that there are no eggs laid in the spring, but the fact that we could find a considerable number of them in nurseries suggests that egg-laying in the spring is very probable.

Mr. Swaine: The specimens that I took at Ste. Anne's were, I think, all taken in the fall. This is some years ago, so I am not quite certain on this point, but believe that they were taken in the fall.

The President: I have no doubt that if any of the members get further information in regard to this beetle hibernating in the adult form they will advise Professor Caesar of the fact, and we will now proceed to the next paper.

Dr. Felt's paper was read by Mr. Gibson.

SIDE INJURY AND CODLING MOTH.

E. P. Felt, Albany, N.Y.

This type of injury has been unusually abundant in the western part of New York State for the past four years. It appears to have been figured and described first by John W. Lloyd in 1907 (Bul. 114, Ill. Agr. Exp't Sta.). He, however, attributed the damage to the work of the second brood.

Investigations the past season established the connection between late-hatching first brood larvæ and this type of injury. Many codling moth eggs are laid in the lake region the latter part of June and early in July on the fruit. The young larvæ hatching from these eggs enter the exposed, smooth surface of the developing apple and excavate a shallow gallery having a radius of approximately 1/16 of an inch. This is probably a manifestation of the leaf-mining habit of the young larvæ, recorded by a number of observers, in relation to those hatching from eggs deposited upon the foliage. A few days after entering the fruit many of the larvæ desert the initial point of injury and make their way to the blossom end. The impulse to desert a perfectly satisfactory shelter and brave the dangers of migration to the blossom end can hardly be explained as other than inherited and an outcome of the same unrest which, under other conditions, leads the larva to forsake the leaf mines and search for fruit. The attempt to enter the apple once more is frequently a failure on sprayed trees, owing to the poison deposited in the calyx cup in the after blossoming treatment. Unfortunately, so far as the apple grower is concerned, the young codling moth larva does not perish until the characteristic mark has been made on what should be an unblemished surface.

Records made during the past four years by Mr. L. F. Strickland, Horticultural Inspector of the New York State Department of Agriculture, show that as much as 20 per cent. of the fruit may be affected in this manner. Investigations by the speaker last summer indicate a somewhat general prevalence of such conditions along the south shore of Lake Ontario. In one orchard at Newfane, 9 to 12 per cent. of the total crop on three sprayed plots bore this side blemish, while in an Orleans county orchard similar plots showed from 25 to 35 per cent. side injury. The unsprayed or check plots in these two orchards had from 30 to 37 per cent. respectively, of the apples thus affected. It should be stated in this connection that very little "side injury" is to be found in Hudson Valley orchards.

The somewhat general limitation of this type of work to the vicinity of a large body of water leads us to believe that this variation in habit may be caused by local climatic modifications. There is on record a statement by Cordley to the effect that eggs are not deposited when the evening temperature falls much below 60° F. In this connection some interesting data has been published by Sanderson (N. H. Agr. Exp't. Sta., 19th-20th Rep'ts., 1908, p. 406). He finds that if evenings be cool, egg laying will sometimes be deferred for several days, and states that from June 9th to 15th, 1906, he was able to secure eggs but after that the evenings were cool until the latter part of the month and no eggs were obtained until June 28th. Again, in 1907, "no eggs were found until June 22nd * * * * though moths had been emerging since the 10th." An examination of records made the past four years by Mr. Strickland shows a fairly close connection between this type of injury and the rise of daily minimum temperatures above 60° F. The damage referred to above occurs mostly the last of June and the first half of July, and so far as records go, is preceded by a period of low temperatures which probably inhibit the crepuscular or nocturnal activities of the moth, and then with the rise of minimum temperatures above 60° F. we have the deposition of eggs and the development of side injury.

The low minimum temperatures from about the time the moths begin to emerge till the latter part of June, do not materially hinder the development of the apple and, as a consequence, when oviposition is possible the fruit is some size, smooth, and from observations in the orchard, appears to be more attractive to the moths

as a place of oviposition than the foliage. Two, three and even four eggs were to be found upon apples here and there, though this would hardly be an average, and more than three-fourths of the eggs found were upon the fruit. This is the reverse of conditions recorded earlier by Messrs. Ball, Card, Pettit and Sanderson.

It will perhaps suffice to state in this connection that in the Hudson Valley, where "side injury" is comparatively rare, temperature records show no such prolonged periods after emergence of the moths begins where daily minimum temperatures fall below 60° F.

The "side injury" phase of the codling moth problem has a very practical bearing, since experiments conducted the past season show it to be extremely difficult, if not impracticable, to reduce damage of this character to a negligible quantity by one season's work. It happened that two of the experimental orchards mentioned above were very badly infested and in one, although the spraying was distinctly above the average, 25 to 33 per cent. of the fruit in certain plots showed the familiar side blemish. This was due largely to the fact that the injury was caused by newly hatched larvæ attacking the poorly, necessarily so, protected surface of the rapidly growing apple. These eggs, it is evident, were deposited by moths developing from hibernating larvæ, consequently this serious "side injury" was the logical development in a badly infested orchard when climatic conditions compel a late deposition of eggs, many of which may be placed on the fruit. This danger, in our estimation, is ample justification for urging thorough and annual sprayings of bearing orchards whether the trees happen to be fruiting or not. There are in most orchards, even if there is no crop, enough scattering apples to carry to maturity a number of codling moths, ignoring, if you please, the fact that Headlee and Jackson observed larvæ which developed to full size in water sprouts.

It is noteworthy in this connection that the experimental orchard of last season, not badly affected by "side injury," was sprayed annually and presumably thoroughly, even when not in fruit. The same was true of some other orchards where there was very little codling moth injury. That this comparative immunity could not be attributed entirely to accident was evidenced by the fact that just across a roadway from the orchard showing almost no injury, trees were found with 75 per cent. of the apples on the ground wormy.

The President: This paper of Dr. Felt's is of great interest to those who are engaged in fruit insect investigations, particularly insects affecting the apple. The Codling Moth damage, of course, is usually internal and quite serious, but on the other hand it is a kind of damage which, even if slight, may produce a blemish on the outside of the apple, which is very serious from the fruit grower's point of view, in view of the fact that it degrades his fruit. You may have a very fine apple, which ordinarily would rank as No. 1, but through some blemish produced in this way by the Codling Moth it is degraded to No. 3. This proves to be very serious in the case of the large fruit grower. In Nova Scotia, Mr. Sanders is making a study of a somewhat similar injury caused by the Budmoth, which also reduces the quality of the apple by a blemish of much the same nature as the one caused by the Codling Moth. I think it might be well to mention here that in his investigations Mr. Sanders found that there was injury being caused by another insect imported from Europe, and he sent me the other day a photograph of the injury caused by this insect, the Lesser Budmoth, *Recurvaria nanella*. As a number of men here have been working on insects affecting apples and fruit generally I have no doubt that they will have something to say in regard to Dr. Felt's paper.

Prof. Caesar: In regard to the matter of side-worms, I may say that every persons who endeavors to spray thoroughly for Codling Moth finds that far the greatest trouble is to prevent the worms from entering the side of the apple, especially if there are two broods and if it is the first season the orchard has been sprayed. I do not know anything about the influence of temperature on this questions of side-worms, but I do know that in Ontario side-worm injury is abundant both on high land and on low land.

Mr. Gibson: Mr. Chairman, I should like to remark that in Dr. Cosens' report which he sent as Director, he makes a brief mention of the occurrence of the Lesser Budmoth on pear trees in Toronto, and he also mentions that it was quite abundant on an apple tree. This insect is treated of in a bulletin published by the U. S. Bureau of Entomology.

The President: If there is no further discussion on this paper we will proceed to the next by Mr. Winn.

THE HOME OF GORTYNA STRAMENTOSA.

Albert F. Winn, Westmount, Que.

This moth is one to which but little space has been devoted in our literature, but being a typically Canadian insect, perhaps you will pardon a longer and more rambling paper than intended for the meeting.

In Vol. XXXII, pp. 61-63 of the Canadian Entomologist, Mr. J. A. Moffat, late curator of our Society, published a copy of Guenée's description of the moth, an enlarged half-tone cut of it and some remarks on its occurrence. This was followed in the same volume by a note on p. 119 by Mr. Grote, and a reply on p. 133 by Mr. Moffat. The species has again been figured by Sir George Hampson in Vol. IX of the Phalænidæ of the British Museum, plate 138, to which we will refer elsewhere. From Mr. Moffat's article we quote the following: "*Stramentosa* has been taken regularly at Montreal for years past by collectors connected with the Branch of the Entomological Society of Ontario there, apparently none knowing of its existence there except themselves. Mr. Brainerd intends to make a vigorous effort to discover its foodplant next season."

Although over fifteen years have elapsed since this was written and we had already been hunting over ten years, the search for its foodplant and consequent laying bare of the life history has been carried on faithfully and well by various members of our Branch, and at last it has fallen to my lot to have the pleasure of entirely solving the mystery of its hiding-place. It is not necessary to particularize the members who have tried to locate it and failed; practically all of us interested in Lepidoptera have searched our Mountain for infested plants possibly tenanted by *stramentosa,* and we had a few years ago the aid of Mr. Henry Bird for a couple of days; but although we were actually within a few feet of scores of larvæ, they were not detected. It is doubtful if any other Canadian insect has had so much time and thought expended on its habits and life history, and as successive seasons closed with the flight of the moths around our street lamps in the fall, and occasional captives on flower heads, we began to feel certain that no visible clue could be hoped for in the plant and that nothing but sheer luck would ever disclose the secret, but we kept on pulling up and splitting down all sorts of possible and some impossible plants.

On the afternoon of September 13th, 1914, while walking along a path on our Western Mountain, near the ski-grounds, looking for edible fungi rather than for insects, I found a *stramentosa,* resting on a leaf of the rattle-snake root (*Nabalus racemosus*) and a minute later disturbed another on a plant of the same species. This plant was given a tug and it broke off short, but the root was easily dug up and was evidently bored. On going back to the first plant, it was also found to have been attacked. Things began to look interesting and mushrooms were put aside for another day. By tramping among the plants and beating them with a stick, a number of the moths were disturbed, either dropping to the ground or flying a short distance and hiding. Among the hundreds of plants in the neighborhood a plant here and there was pulled up and most of them showed they had been bored, and we felt so sure that the long-sought for plant had been stumbled across that a supply of seeds was sent to Mr. Bird so that he might have a supply of plants in his "garden of borers" at Rye, N.Y., ready for the larvæ that would follow another season.

Early this June, when the larvæ of the borers were beginning their work in burdock, thistle, cicuta, iris, etc., the same locality was visited, but the Nabalus plants were hardly visible above ground and those dug up showed no sign of attack. We concluded that we were too early, for the moth being later in appearing than most of the borers, it seemed possible that the egg was also later in hatching. The next visit was three weeks later and the plants were about two feet high, but the most careful search failed to find any trouble. Something had evidently gone wrong with our discovery of the previous fall and *stramentosa* was still surrounded by a mystery. One thing was very certain, however, namely, that if I had disturbed a dozen or so of the moths there must have been in the neighborhood scores or hundreds that were not seen, and as the number of examples seen about the lights each year was about uniform, there *must* be a lot of larvæ close at hand. If they were not in Nabalus, they must be in something else growing commonly there. Fortunately I was in a clear patch on a hillside and could get a sort of bird's-eye view of the tangle of weeds and undergrowth. A plant was noticed that we had seen in many places on Mount Royal Park and an isolated clump was selected. There was no wilted top nor brown leaf to indicate attack, but on splitting the longest stem down from the top, a boring was struck about a foot from the ground and a section containing the little larva was quickly boxed. Other plants were similarly treated but nothing was found, and it looked as if our day's take was going to be only one larva. Something suggested that we were again off the track, so we opened our box, removed the larva from its boring and had a good look at it. It was seen to belong to a different genus—*Papaipema,* probably *P. cataphracta,* and such it proved to be. This in itself was rather a discovery, as the insect, though common enough in Ottawa and elsewhere, is seldom found with us, and it seemed remarkable that the very first stem selected to be split open should have contained a larva, which prevented my continuing the process down to the ground, which is the simplest way of locating boring larvæ in their earlier stages. We could not recollect ever having pulled up a clump of this plant on any previous occasion and as we looked at the erect stems with their perfect foliage surmounted by the forming seed pods, which later on rattle merrily when touched, it seemed incredible that they should be bored; and yet, that little cataphracta had been in one stem, equally perfect externally. A cluster of stems coming from one root was grasped and given a tug. Up it came, and after giving it a shake, a fine fat larva about 1¼ inches long was seen shuffling back into its burrow. As we were extricating him, another dropped to the ground and was secured. This surely was our quarry

at last. Another clump was pulled up, two more larvæ and so on, as many as eight being taken in one clump and no blanks, every clump seemed to be attacked. Other plants noticed here and there on the way home were examined and proved to harbour larvæ in their roots. There was, henceforth, no shadow of doubt as to the home of the *stramentosa.* But what was the plant's name? I tried to determine it by Gray's Manual of Botany, but was misled by the square stem in trying to locate it among the members of the Mint family. A specimen was sent to the Dominion Botanist and Mr. Adams kindly determined it as belonging to the genus *Scrophularia,* but did not like to state the species owing to the absence of flowers. On referring to Britton and Brown's Botany, our plant was easily recognized by the cut and description as being *S. leporella*—the hare figwort—but to make doubly sure, the original description was turned up in Vol. 33, p. 317, Bulletin of Torrey Botanical Club (1896)—so *stramentosa* may be given the common name of the "Fig-wort borer."

As I was leaving town for my holidays within a few days, the bulk of the larvæ and roots were packed up and sent to Mr. Bird, only a few being kept as I felt sure that on my return any desired quantity of full-grown larvæ could be secured and that the pupæ would be likewise found in due season. Mr. Bird was away on a *Papaipema* hunt in Illinois when the package arrived, but his son looked after it and was successful in obtaining the imagos and so quickly that we might almost suspect that he used an incubator in his anxiety to get the first bred *stramentosa.* On my return I found several larvæ had pupated, while the rest died of starvation owing to the drying up of the roots. A series of wet days and other contingencies prevented my getting any time to visit my hunting-ground till Saturday, August 20th, by which time it was supposed all would be in pupa. In the first clump selected a larva was found and evidence that there had been another, so I proceeded to get out my entrenching tool and began scraping away the earth carefully. At a depth of about two inches a fine yellowish-brown pupa lay exposed, wriggling about in a very lively fashion as if not at all appreciating being disturbed. Proceeding to a nearby clump resulted in two more—then six, which is the most found under one plant, and in the course of three-quarters of an hour, thirty had been boxed. Reluctantly we were compelled to stop, as the drizzling rain which had been falling was becoming heavier and the vegetation was decidedly moist to work among. The pupæ were all found in the same situation as the first, namely not over two inches below the surface, invariably on their sides, without any cocoon or cell and wriggling much when disturbed. All were within a foot's radius from middle of root. The question occurred: how would the moths emerge from those earthy homes? Would they force their way through the soil or would instinct tell the pupæ to come to the surface? Having brought home a supply of soil from the woods a layer was put in two breeding cages, 18 pupæ were placed in one cage and 12 in the other, all in a horizontal position, and were covered with about two inches of soil and on top was an inch or more of the *prepared fibre,* sold by the florist for growing bulbs. This I find an excellent material for keeping burying pupæ moist enough without inducing mold. Two days later the question was answered. Seventeen of the pupæ were visible, some were on their sides, but most of them were nearly vertical, tail up. To what extent the cremaster aids the tunneling process was not ascertained, but its structure is suggestive that it might be useful.

On August 30th my first moth appeared. The following evening I went straight from the office to the woods but it was nearly 6.30 when the ground was reached and four pupæ were all that were secured in what remained of the daylight. The next Saturday afternoon, September 4th, was warm and bright, rather too

warm in fact for digging operations. Pupæ were found nearer the surface and two sticking up on end, cremaster up, as in the cages. Collecting at this date, though successful, is difficult, for the digging implement is almost sure to injure about as many pupæ as it unearths sound ones, so after cutting in two or dinting over twenty a piece of wood was substituted. It was not much improvement as the extra force required to use it bruised the pupæ instead of cutting them in two. On returning home it was found that twenty-six sound pupæ was the result of the outing. But this was not all, for two larvæ were found, one evidently sickly, the other full-grown and well below the ground ready to pupate. One empty pupa shell was also picked up and the plant above searched for the moth. Whether it was this one or another I disturbed during my search cannot be said, but happening to look down a moth was seen running along among the leaves on the ground and took refuge under one of them. When disturbed, she ran off and finally hid under another leaf—the performance exactly resembling that of *Amphipyra tragopogonis* which in England has earned for itself the common name of *The Mouse*. Several other moths had by now emerged in the cages and many pupæ were darkening up in color, betokening early emergence. In doing this one escaped and fell to the floor, without attempting to use its wings, and immediately scurried about on the floor in search of a hiding place. It was noticed that the moths in the cages all appeared to try to squeeze themselves as close into the dark corners as possible, often remaining two or three days without altering their relative positions. It is, of course, possible that during the night they may have flown or moved about and returned to their post before morning, but the habit of secreting themselves by day is evident.

Having a supply of living moths the next point was to secure eggs, and not having any experience in getting bred specimens of Noctuids to mate in captivity, I tried every plan I have ever used in the case of moths belonging to other families, but was unable to get a pairing among themselves, and freshly emerged females placed on the inside of screen doors and taken into the woods failed to "assemble" any flown males. Finally a large skeleton box, about thirty inches each way, covered with netting, was put in the garden, with stems of several figwort plants stuck vertically in the ground, as well as the cuttings of such perennials as were in flowers and some twigs and leaves smeared with sugaring mixture. After feeding all the moths forcibly, they were turned into the moth paradise. Two days later, success was attained, one moth having selected a blue-bell, and in the axil of the leaf deposited a cluster of eight eggs, irregularly placed, while lower down on the same stem were about ten eggs in a crooked line, the lowest barely an inch from the ground, and the moth was hiding under the lowest leaf which was drooping and provided a suitable shelter. The moth was brought indoors and placed in a breeding cage with cuttings of figwort and blue-bell stems, but evidently they were not attractive-looking, for the moth would not use them, but placed eggs in all sorts of places in corners, on the glass door, loose on the bottom and most curiously on and in the empty pupa cases of its own kind. It was hoped, by observing where eggs were laid in confinement, that the habits in nature would be indicated, but the results were unsatisfactory. In no case did it seem as if the eggs were placed otherwise than as a sort of makeshift, although the use of the axil of leaf and inside of pupa cases hinted that they would probably be concealed, that is thrust in somewhere; which might have been presupposed. However, knowing what the eggs looked like, and armed with a reading glass, we proceeded to the hillside the next Saturday afternoon and looked over the plants from the ground to the top seed-vessels. The inside of the latter were very carefully examined, as well as the little

cluster of leaves closely pressed together at the foot of the plants ready for next year's growth. Nothing was found, and it looked as if the old saying about looking for a needle in a hay-stack might be revised to cover looking for a moth's egg on a mountain. Next day I was in a different place, but seeing some of the figwort, pulled up a clump just to see whether it had been attacked. It had—very much so. All of a sudden it occured to me that the natural place for eggs to be deposited to secure a ready access to food supply in spring had been overlooked, and that the habit of the female running on the ground should have been a sufficient clue. As is the case with many tall perennials that are bored, there remains of the previous year's stem a little tube extending a few inches above ground and forming a natural tunnel straight to the roots. Hastily, but carefully, with a penknife this was split open and four eggs were revealed. Others were found, as many as twelve in one case, and some of them were so slightly attached that many others may have dropped down the hole. This, of course, may not be the only place the female selects, but it satisfied me that in 1915 a good deal had been found out about the home of *stramentosa*. There is one brood per annum, the egg hibernates, the larva feeds wholly in the roots of the figwort, matures about the middle of July to August 10th, the pupa lies beneath the plant about two inches below the surface, bores its way to the surface tail first, the moth, emerging, tumbles the pupa over, and climbs very rapidly up the plant's stem, stops, holds its soft wings by its sides for eight to ten minutes, then when about half expanded, suddenly flaps them together over the back like a butterfly at rest, and remains in that position till the wings are fully developed, or about half an hour. The wings are then lowered, and the moth crawls into a corner and stays there. How long it takes for the wings to become dry enough for flight was not ascertained. Most of the moths emerged between five p.m. and eight p.m. No parasites were observed, but indoors the wriggling pupæ proved enticing to a pair of mice, and one of my small cages having a cotton netting in front was entered, with the result that there was a round hole in the net and the chrysalids went away inside the mice. They were evidently relished, for next night a trap caught one mouse and the following night the other. This suggests that field mice may greatly reduce the number of pupæ after they come up and wriggle about on the surface of the ground. The moth most closely allied to the figwort borer—*G. immanis,* the hop-vine borer—is said to be considered as a particularly choice delicacy by skunks (Can. Ent., XIV, 93-95), one hop-grower stating that he had seen ten acres where not a dozen hills had escaped their little noses. It may be that the absence of this odoriferous mammal from the neighborhood of Montreal has given *stramentosa* a chance to increase in the land.

Detailed descriptions of the various stages will be published shortly by my good friend, Mr. Bird, as in view of his wonderful knowledge of the life histories of the boring Noctuids, it seemed more in the interests of science that the making of descriptions and comparisons should come from his pen than from mine.

The President: We are very pleased to have Mr. Winn's paper, and I should like to thank him for the specimens of this interesting moth which he has placed in our National Collection here. It has been said to me by a keen external observer of the activities of this Society for many years that there is a preponderance of economic papers in our programme, and that this is not as it used to be, that in the old days there were more papers of a purely scientific character by such men as Mr. Winn, who are not professional entomologists but who follow entomology as their chief hobby. For that reason we are especially pleased to have Mr. Winn's paper. It would be a very bad day for the Society when papers of such a nature cease to appear in our proceedings, and for that reason also we shall look forward

to hearing a number of other papers by our old friends who are not professional entomologists, such as Dr. Fyles' paper this afternoon and Mr. Morris' paper tomorrow. The paper is now open for discussion.

Mr. Gibson: The study of these Lepidopterous boring larvæ such as Mr. Winn has told us about is one which has always given great pleasure to those who are interested in rearing the larvæ of our moths. We have not, as yet, found this insect at Ottawa, but now that we know more about the larvæ and what they feed upon we hope that we may be able to find the species. The chief boring larva of this family which occurs in the Ottawa district is called the Burdock Borer, *Papaipema cataphracta.* This is quite a pest, some years attacking soft-stemmed flowering plants, such as dahlia, lily, etc., and in addition, of course, it occurs in burdock and thistle. I am very glad to know that Mr. Winn has donated specimens for the collections here.

Sir James Grant: Mr. President, I should like to make a few observations. I am happy to inform you that after a very careful survey of the Dominion of Canada, from Victoria on the Pacific to Halifax on the Atlantic, through the whole of Central Canada and New Ontario, that the work of this Entomological Society has proved of great practical value to Canada in the Department of Public Health. The information that you have given to our people on the part played by the house-fly as carriers of disease has conserved very materially the life of the people of Canada. Those house-flies play, as you know, a very important part in the dissemination of tuberculosis from sputum. There is now, I am happy to inform you, as you will find in my report recently presented to the Canadian Public Health Association at Toronto, a reduction in the past fifteen years of fully twenty-five per cent. in the number of cases of tuberculosis. I have lately gone through whole sections of Central Canada where fifteen years ago the disease was very common, indeed, hundreds of cases in nearly every direction. To-day, with difficulty, in those sections can you discover a solitary case of tuberculosis, and I am happy to inform this Association that if they continue the good work they have done in the past in the preservation of health by similar measures, and by the destruction of the house-fly, I am confident that the next ten or fifteen years will bring about a reduction of this disease of fully fifty per cent. The head of the Pasteur Institute, Paris, France, has recently announced that throughout the whole of Europe there is now a reduction of fully twenty-five per cent., and I am very glad, indeed, to have accepted your kind invitation to attend this meeting to thank you and the members of this Association, for the active part taken in instructing our people, as to the vast importance of the destruction of this house-fly, which is undoubtedly very instrumental in the production of the death rate from tuberculosis.

Dr. Hewitt: We are very pleased to have Sir James Grant with us and I hope that he will attend as many sessions as he can and hear other papers of interest.

INSECTS OF STE. ANNE'S, QUE., SEASON OF 1915.

E. Melville DuPorte, Macdonald College, Que.

During the past season there were outbreaks of several injurious insects at Ste. Anne's and the surrounding country, the most important of which are discussed below.

Grains and Clovers.

The Frit Fly (*Oscinis carbonaria*) along with the Wheat Stem Maggot (*Meromyza americana*) caused appreciable injury to small grains. These insects which have not, at least within recent years, been destructive in this region were more plentiful than usual.

Hessian Fly injury was observed by Mr. P. I. Bryce in the experimental plots at Macdonald College. Hitherto these plots have been free from this pest. As the plots worst affected were in the neighborhood of a manure pile it is practically certain that the insects were brought in with the manure.

The more important insects of the clover during the season were the Clover Seed Chalcid (*Bruchophagus funebris*), The Lesser Leaf Weevil (*Phytonomus nigirostris*), The Clover Mite (*Bryobia pratensis*), The Pea Aphis (*Macrosiphum pisi*), and *Tychius picirostris*. The Seed Chalcid was quite destructive during the seasons of 1913 and 1914. The injury due to it was not so marked during the season under discussion, but its work was supplemented by that of the Lesser Clover-leaf Weevil, the larvæ of which destroyed a fair proportion of the red clover seed. The Clover Mite was quite abundant in the latter part of the season.

Locusts. The locust outbreak was very severe in the Province of Quebec during the past season. Not only forage and field crops, but some garden crops were severely injured. The species most numerous and causing most injury at Ste. Anne's was the red-legged locust (*Melanoplus femur-rubrum*). *M. bivittatus* was also quite numerous. At Macdonald College the poisoned bran mash, Kansas formula, was used to protect the experimental plots. For some reason the mortality among the locusts was not as high as expected. The incursion of locusts from neighboring untreated fields increased the difficulty of controlling the pest and for this reason strong emphasis should be laid on co-operation among farmers in combatting these insects.

Field and Garden Crops.

Cutworms. Another very serious outbreak of cutworms occurred in parts of the Province, causing considerable injury to garden and field crops. At Ste. Anne's the species responsible for most of the injury was the striped cutworm (*Euxoa tessellata*), but a few white cutworms and red-backed cutworms were also found. Several parasites of these insects were actively at work, and the relatively small number of moths observed holds out some hope that the cutworms will be less destructive next year.

Root Maggots. Both the cabbage root maggot (*Chortophila brassicæ*) and the seed corn maggot (*Chortophila fusciceps*) were the cause of much injury to cruciferous crops. In some turnip fields a large proportion of the plants was destroyed by the seed corn maggot even after the tops were practically full grown and the roots had attained a fair size. The carrot rust fly (*Psila rosæ*) was more injurious than usual this year, causing considerable loss in small kitchen gardens.

The Beet-Leaf Miner (*Chortophila vicina*) was injurious at Ste. Annes to mangels, beets and spinach. Complaints were received also from other parts of the Province.

The Hop Flea-Beetle (*Psylliodes punctulata*). Beets and mangels were badly attacked by this insect in the early part of the season. It was the only flea-beetle which occurred in very large numbers at Ste. Anne's.

The growing of parsnip seed for the first time at Macdonald College introduced there a new pest, the Parsnip Web-Worm (*Depressaria heracliana*), which greatly reduced the yield of seed. This insect is always present in the wild carrot at Ste. Anne's but has not before given us any trouble.

Orchard and Small Fruits.

The Plum Slug (*Eriocampoides limacina*) was very destructive during 1913 and 1914, and judging by the number of adults which emerged last spring and the number of eggs laid, I expected a severe outbreak this season. The eggs, however, were so effectively parasitized by the chalcid *Pentarthron minutum* that it was not even necessary to spray for the slug.

The Budmoth (*Tmetocera ocellana*) continues to be injurious in various parts of the Province, especially in poorly kept orchards. Its parasites were at work, *Pentarthron minutum* being most active. Experiments on the control of the budmoth larvæ indicated that they could be kept in check by the application of two sprays, one three days before the blossoms open, the other shortly after the petals fall. It was also found that lead arsenate at the rate of 2½ lbs. per 100 gallons of spray, applied at the end of June while the eggs are on the leaf, will destroy a very large proportion of the newly hatched larvæ.

The Cigar Case Bearer (*Coleophora fletcherella*) was present on unsprayed trees but gave no trouble in well kept orchards.

The work of the Buffalo Tree-Hopper was very evident in some orchards. In a young orchard of about 4,000 trees, not far from Ste. Anne's, this insect has dwarfed and deformed several of the trees to such an extent that they are practically valueless.

Among the insects injurious to small fruits the more important were the Currant Saw Fly, the Raspberry Saw Fly, and the imported Currant Borer.

THE OCCURRENCE OF TYCHIUS PICIROSTRIS ON CLOVER AT STE. ANNE'S, QUE.

E. Melville DuPorte, Macdonald College, Que.

Last May I noticed that the leaves of red clover which forms a cover crop in an orchard at Ste. Anne's were being destroyed by a small snout beetle. This insect was present in large numbers feeding gregariously on the leaves, in many cases upwards of twenty being found on a single leaf. On being disturbed the weevils readily "feigned death" and fell to the ground. Specimens sent to the United States Bureau of Entomology were identified as *Tychius picirostris* by Mr. E. A. Schwarz.

Later in the season, as soon as the clover came into bloom, the insects deserted the leaves and attacked the flower heads in which they remained throughout the season. My latest record is dated September 28th.

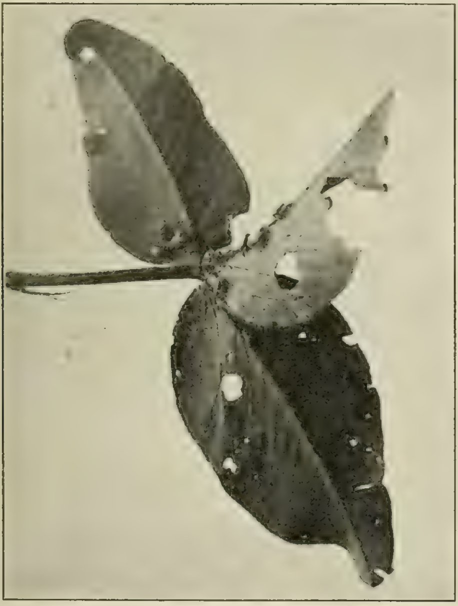
The weevil was found in practically all fields of common red and mammoth red clover in the neighborhood of Ste. Anne's, but did not seem to attack other varieties.

The adult beetle is a small curculio about 2.25 mm. long and 1 mm. broad. The interspaces of the elytra are thickly clothed with narrow, hair-like, procumbent

scales, the elytral striæ are naked. The ventral side of the body bears somewhat broader scales. Pronotum punctate; not much narrower than the elytra; its length about equal to its greatest breadth; narrowed in front; the scales on the pronotum and also on the legs are similar to those on the elytra. The head is sparsely clothed with fine hairs; the beak is about as long again as the head and clothed at its basal end with scales like those of the elytra.

The scales of the elytra and prothorax give the weevil a pale olive green colour, but they are rubbed off as the insect gets older, leaving the elytra and pronotum bare so that the insect gradually assumes a dark brown colour.

Tychius picirostris is not an indigenous form, but has been introduced from Europe where it attacks the flower heads of red clover, plantain and *Genista.* It has not before been recorded as injurious in North America though I learn from



Tychius picirostris on clover leaf. (Original.)

Professor F. M. Webster that it has been collected at Ithaca and Oswego, N. Y., and at Framingham, Mass. I have observed it at Ste. Anne's for several years, but not before in sufficiently large numbers to be regarded as injurious.

The President: Mr. DuPorte is to be congratulated on his account of his season's work, which indicates how very active he has been and to what good purpose he has directed his attention. We here have been particularly interested in his observations on *Tychius picirostris*, this new pest of clover, and probably Mr. Gibson has some remarks to make about this.

Mr. Gibson: We have a specimen in the collection which may possibly be this species and which is from Brockville. We have not, however, examined it carefully enough to be certain. I was glad to hear of the eastern occurrence of the Hop Flea-beetle, which Mr. DuPorte referred to.

Prof. Lochhead: I would like to remark in regard to Mr. DuPorte's papers that I had not much time to give to the work done by Mr. DuPorte, who is a member of the Biology staff of Macdonald College as investigator under the Dominion Federal Agricultural Institution Act. He has done a great deal of work of which this is a small fraction, and he has other more elaborate work at hand. It is especially in the line of anatomical work that his investigations are valuable. I know of no person in Canada who is more adept or more patient in the unravelling of minute anatomy than Mr. DuPorte, and we may expect to hear of some of his investigations a little later. He had the honour of presenting a paper to the Royal Society last year, and I feel sure that Mr. DuPorte will favor us year after year with his attendance and give an account of his work.

The President: If there is no further discussion I think we will conclude this morning's session.

THURSDAY, NOVEMBER 4th—AFTERNOON SESSION.

The President: We are to begin the afternoon session with a paper by Dr. Fyles. Dr. Fyles needs no introduction to the Entomological Society. He is the oldest member among us, and when he said last year that the paper he presented would be probably the last I well remember disputing the fact with him, and apparently my own prophecy has proved correct in that we are to enjoy another paper by Dr. Fyles entitled "Observations Upon Some of the Predaceous and Parasitic Hymenoptera."

OBSERVATIONS UPON SOME OF THE PREDACEOUS AND PARASITIC HYMENOPTERA.

Rev. Dr. Fyles, Ottawa.

One day in summer, I was sitting under the verandah of a friend's house, at Hull, when I noticed a specimen of *Pelopæus cementarius* Drury, exploring some webs that had escaped the notice of the mistress of the dwelling. The creature was in search of spiders, wherewith to provision the mud castles that it was building for its young. This incident suggested the subject of my paper.

The question entered my mind, How can I obtain a supply of the mud structures for use in the preparation of the article? I bethought me that boys are privileged, and can go where older persons cannot, without being regarded as intruders, so I asked the aid of one of Baden Powell's boy scouts, and not in vain: for next day he obtained for me an ample supply of the castles, from an unused attic of a neighboring house.

Pelopæus cementarius has practised the business of pottery from the creation of the world that now is. Its instinct impels and guides it, and its work is accurately done, according to its need.

I have watched the insect preparing material for its building.

In the grounds of the late Mr. Quartus Bliss, at Compton, in the eastern townships, there was a horse-trough hewn out of a huge basswood log. The water was supplied by a spring, and its overflow escaped at one end of the trough, through a circular cut, and formed a puddle in the clay ground. One day, when on a visit to Mr. Bliss, I saw a number of mud-wasps at this puddle gathering soil, tempering it with their mandibles, and then flying away with pellets of the cement.

The cells brought to me were in masses, and probably numbered two hundred. They reminded me of dirty peanuts jammed together. Within each was a long oval chamber, at one end of which were the remains of the spiders on which the inmate had fed. Next to these was a hard cap, rough and rounded on the outside, and concave and polished on the inside. Attached to this was a case, yielding to the touch, and somewhat brittle, but strengthened by a fine silken covering, which I found could be peeled off.

The case was semi-transparent. The form of the waxen larva, free and unattached, could be seen through it. Examined through a glass it appeared to be formed of a like silken texture as its covering, but smoothed and compacted by a vehicle that resembled glue or varnish.

Grub of *Pelopæus cementarius* (Drury) in the month of November.

As the case was complete, and the remains of the spiders on the outside of it, its occupant must have ceased to feed.

The perfect Pelopæus is a grim object, very active, very forbidding. Its "frightfulness" is its protection. It seems to say, "You let me alone, and I'll let you alone." In reality it is one of our insect friends.

I think three spiders for each would be a low estimate for the provision made in the cells brought to me. That would give 600 spiders collected in the immediate vicinity of the house in which the cells were found. Now, when you call to mind how prolific the female spider is, you will be able to form a faint idea of the terrible and disgusting plague from which the mud-wasps preserve us.

But the spiders have their use in the economy of nature. Are there no counter checks against the undue increase of the mud-wasps? Yes, several ichneumon-flies have been recorded as preying upon them: for instance, *Cryptus junceus* Cresson (Am. Ent., Vol. I, p. 137).

Some years ago, I had a batch of Pelopæus cells in my study window. One day, when the wasps were breaking from their domiciles, I found a specimen of *Sarcophaga prædator* Zabriski in the window. I can only account for its presence by supposing that it came from one of the mud cells. If my surmise is right, how can we account for the presence of intruders such as this in the mud castles

of the wasp? I think that Prof. W. S. Blatchley, in "Woodland Idyls," pages 206-9, has supplied an answer. He tells that he saw an ichneumon light upon a spider, *that a wasp was carrying off,* and deposit an egg in it.

Zabriski found *S. prædator* in the nests of *Vespa maculata* Linn., and *Vespa germanica* Fabr., insects of widely different nesting habits. Has it a wider choice of domiciles? It may have.

The Digger Wasps should be numbered among our insect friends.

One summer day, a few years ago, I was walking in the beautiful cemetery at St. Joseph de Levis when I came to a bare and unused portion of ground. The soil was light yet not friable. It seemed to be just suitable for the operations of *Bembex fasciatus* Fab. About a score of these insects were in sight, some of them sinking shafts in the ground; others storing their shafts already completed with Blue-bottle flies.

It must be told here that a considerable tract of Government land lies near the burial ground which I have spoken of; and that some of the dwellers in the vicinity were guilty of the reprehensible practice of carting their garbage out to this waste land, and leaving it there uncovered. It was not surprising that Blow-flies were plentiful in the neighborhood, and that Digger Wasps and Carrion Bettles were plentiful there, too.

I once saw *Ammophila communis* Cresson, staggering along with a caterpillar larger than itself, and then burying it in a hole previously prepared.

The monarch of our Canadian ichneumons is undoubtedly *Thalessa atrata* Fab.

On the 17th of June, 1899, the Quebec Branch of the Entomological Society, which was then in a flourishing condition, held a field day in the grounds of Mr. Harper Wade, of New Liverpool, Quebec. Mr. Wade's house is on a bluff overlooking the St. Lawrence. Behind it is an extensive lawn bordered by ornamental trees and shrubs. At the time of our visit a huge maple log had been sawn into blocks of stove length, ready for the splitting; but the owner had placed them here and there, under the trees, for rustic seats. On approaching one of these I found several female specimens of *atrata* in the act of depositing their eggs, while others of the species were darting about in the vicinity. Each block had its visitors of the kind attracted by the larvæ of *Tremex columba* Linn., which were tunneling in the wood. But how were the ichneumons attracted? Was it by some subtile emanation from their victims? Who can say?

There are trees on each side of the street on which I live. A Red Maple (*Acer rubrum*) is growing a few yards from my door. On the 16th of June, 1912, looking from the portico over this door, I saw an assembly of ten or a dozen males of *Thalessa lunator* Fabr. The insects were clustered on a spot where a limb of the tree had been lopt some years before.

There was apparently much agitation amongst them. Before night two females made their appearance from the wood; and then the males dwindled in number. Only the two females remained next day.

What attracted the male insects to the spot where the females were about to show themselves? Was it scent, or sound, or some influence we know not of?

While speaking of the Longtails let me say that some years ago, I took on the Heights of Levis a Thalessa of great rarity. It is about the size, and of the same rich sienna-colour as *Thalessa lunator* Fabr., but very different in its markings. Instead of the lunettes which are seen on the abdomen of *lunator*, there are, on each side of the 3rd, 4th and 5th abdominal segments of the insect I am speaking of, a bright crome-yellow circle upon a black fascia which passes round the segment. I presume that this insect is *Thalessa nortoni* Cresson.

Epialthes gigas Walsh, which closely follows the above in our lists, has a forbidding appearance. Epialthes (Gr.) means a *nightmare, one that leaps upon you.* Not a bad name! Decidedly it is better to have the insect preserved in the cabinet than alive in the bed-chamber.

I have in my collection, amongst many other useful insects, representatives of twenty-two species of the genus *Ichneumon.* They attack the Noctuids. I have seen *Ichneumon lætus* Brullé break from the emptied skin of a cut-worm.

The micro-hymenoptera are valuable friends to man. I have here a family of 103 specimens of *Apanteles longicornis* Provancher, which fed in one Tussock caterpillar, and then spun their cocoons around the remainder of their victim.

To show how thoroughly the work of the micro-hymenopterous parasites is done, and how important it is, in sometimes un-noted directions:

Those who have stood on a Quebec wharf in the blueberry season, and seen the Saguenay steamboats discharging their freight, will have noticed the stacks of rude boxes, made of slabs from the sawmills, and filled with blueberries, landed there; and they will have witnessed the eagerness with which dealers have made bids for them. The reflection will have come into their minds, what an important source of revenue—what a provision of food—the blueberry crop must prove, to the poor inhabitants of the Chicoutimi and Saguenay wilds, and how serious a loss to them its failure would be.

In May, 1895, I sent to Mr. Wm. H. Ashmead, a number of galls that I had found on the blueberry bushes at Levis, and specimens of the flies that I had raised from them. Mr. Ashmead replied:

"The gall on Vaccinium is my *Solenozopheria vaccinii* described in 1887 (Trans. Am. Ent. Soc. XIV, p. 149).

"The parasite reared from it is my *Megorismus nubilipennis.* The gall occurs abundantly on various species of Vaccinium, in all parts of the country, but the maker is extremely rare; and the only one known, so far as I know, is my single type specimen. I took the gall by the hundreds, and have never reared but one specimen of the gall-maker; all other things reared from it being parasites. I have reared several distinct species of micro-hymenoptera from it, although of these the *M. nubilipennis* was the most common."

One of the most brilliant little micro-hymenoptera came under my notice in peculiar circumstances, and has remained a memory and a mystery to me to this day. The late Mr. Joshua Thompson, of D'Aubigny Villa, Levis, sent to me one day in July, begging me to come and see his plum trees. The trees were loaded with half-grown fruit; and a most remarkable invasion of the trees had occurred. I never witnessed anything like it. There were myriads of tiny hymenopterons upon them. I counted as many as thirty on one plum. The females of the species had their ovipositors thrust deep into the fruit.

I submitted specimens of the insects to Mr. Ashmead and he declared them to belong to a new species. I named them *Torymus thompsoni,* and I published a full description of them in the Thirty-fourth Ann. Rep. of the Ent. Soc. of Ont., page 10. The type of the species is in my collection in Ottawa.

I had previously raised specimens of *Torymus sackenii* Ashmead, from blisters on the leaves of Golden Rod.

In the valuable series of Farmers' Bulletins issued by the Bureau of Entomology, at Washington, there appeared lately an article by Mr. F. M. Webster, which reminded us of a time when the hearts of men began to fail them for fear because of the devastations wrought in their grain fields by the Hessian Fly. Where this insect comes in its strength—to use the words of Mr. Webster—

"hundreds of thousands of acres of wheat may be either totally, or so badly injured as to reduce the yield 50 to 75 per cent., and the monetary losses expressed in dollars would run far up into the millions."

Agriculturists, at the time I have alluded to, were at their wits' end to discover checks upon the destroyers. The checks came, but they were not of man's devising. Doubtless, in the beginning of the world that now is, such interruptions and disturbances in the order of nature, as the Hessian Fly plague—

"Deep in God's foreknowledge lay."

And it was He who brought to bear the minute antagonists of the fly, that are so well figured in the bulletin I have mentioned, viz.: *Polignotus hiemalis, Merisus destructor, Platygaster herrickii, Bæotomus subapterus.*

A bulletin on the Hessian Fly has also been written by Mr. Norman Criddle, and published by direction of the Minister of Agriculture, Ottawa. In it a full description of the pest, its life-history, and its operations are given. A reference to its hymenopterous parasites is also made.

Such investigations as Mr. Webster and Mr. Criddle, and others of our practical Entomologists, are carrying on, dignify our favorite study, and raise it far above trivialities and hobbies. In following out the life-histories of our insect friends and insect foes, and showing how wonderfully they work for the general good, they—

"Justify the ways of God to man."

In pointing out the best methods of operating under the vicissitudes of nature, of remedying evils, and advancing benefits, their work is ennobled, for the are "workers together with God."

HYMENOPTERA PARASITICA—ICHNEUMONIDÆ TAKEN IN THE PROVINCE OF QUEBEC BY THE REV. DR. FYLES.

ICHNEUMONIDÆ.

Ichneumon annulipes Cresson. Levis, rare.
Ichneumon canadensis Cresson. Levis, common.
Ichneumon cincticornis Cresson. Levis, common.
Ichneumon comes Cresson. Levis, common.
Ichneumon creperus Cresson. Levis, common.
Ichneumon extrematus Cresson. Levis, rare.
Ichneumon flavicornis Cresson. Levis, common.
Ichneumon flavizonatus Cresson. Levis, common.
Ichneumon grandis Brullé. Levis.
Ichneumon insolens Cresson. Levis.
Ichneumon jucundus Brullé. Levis, rare.
Ichneumon lætus Brullé. Levis, common.
Ichneumon malacus Say. Levis, rare.
Ichneumon paratus Say. Levis, rare.
Ichneumon pictifrons Cresson. Levis.
Ichneumon promptus Cresson. Levis, rare.
Ichneumon rufiventris Brullé. Levis, rare.
Ichneumon sublatus Cresson. Levis, common.
Ichneumon unifasciatorius Say. Levis, common.
Ichneumon versabilis Cresson. Levis, common.
Ichneumon wilsoni Cresson. Levis, rare.
Ichneumon xanthropus Ashmead. Levis, rare.
Amblyteles indistinctus Provancher. Levis, rare.
Amblyteles quebecensis Provancher. Levis, rare.
Amblyteles rufizonatus Cresson. Levis, rare.
Amblyteles subrufus Cresson. Levis, common.
Amblyteles saturalis Say. Levis, rare.
Trogus brullei Cresson. Levis, common.

Trogus copei Cresson. Levis, common.
Trogus exesorius Brullé. Levis, common.
Trogus fulvipes Cresson. Levis.
Herpestomus hebrus Cresson. Levis, rare.
Trychosis tunicula-rubra Fyles. Levis.
Cryptus americanus Cresson. Levis, rare.
Cryptus extrematis Cresson. Levis, parasitic in *Samia cecropia.*
Cryptus robustus Cresson. Levis, rare.
Hemiteles mucronatus Provancher. Levis, parasite of *Tricotaphe levisella* Fyles.
Hemiteles utilis Norton. Levis, secondary parasite in Acronycta larvæ.
Ophion macrurum Linneus. Levis, parasitic in the Saturnians.
Ophion purgatum Say. Levis, common.
Exochilum fuscipenne Norton. Levis, common.
Exochilum mundum Say. Levis, common.
Heteropelma flavicornis Brullé. Levis, common.
Opheltes glaucopterus Linneus. Levis, parasitic in *Cimbex americana.*
Paniscus geminatus Say. Levis, common.
Campoplex glaucus Norton. Levis, rare.
Campoplex laticinctus Cresson. Levis, rare.
Exetastes rufofemoratus Provancher. Levis, common.
Exetastes suaveolens Walsh. Levis, rare.
Sphecophorus prædator Zabriskie. Hull parasitic in nests of Vespa.
Polyblastus quebecensis Provancher. Levis.
Exyston humeralis Davis. Levis, rare.
Bassus tripicticrus Walsh. Levis, rare.
Arotes amœnus Cresson. Levis.
Arotes vicinus Cresson. Iron Hill.
Thalessa atrata Fabricius. New Liverpool.
Thalessa lunator Fabricius. Sherbrooke, common.
Thalessa nortoni Cresson. Levis, very rare.
Ephialtes gigas Walsh. Levis.
Pimpla annulicornis Cresson. Levis, rare.
Pimpla conquisitor Say. Levis, common.
Pimpla inquisitor Say. Levis, parasitic on *Hylotoma pectoralis.*
Pimpla pedalis Cresson. Levis, common.
Pimpla pterelas Say. Levis.
Pimpla tenuicornis Cresson. Levis, rare.
Lampronota americana Cresson. Levis, common.
Lampronota punctulata Cresson. Levis, rare.
Lampronota varia Cresson. Levis, rare.
Xytonomus stigmapterus Say. Levis.
Echthrus abdominalis Cresson. Levis.

The President: Dr. Fyles, I should like to express on my own behalf and on behalf of the members here our great appreciation of your address, especially your peroration and your tribute to those practical entomologists who, in their work, are rather apt to forget that aesthetic and beautiful side of entomology which you so well express, not only in this but in your previous papers. Your reference from time to time of discoveries you made fifty years ago make so many of us here feel how really very young we are, and how much we have to learn from our predecessors in entomological investigation and study. I have always felt, sir, that the papers and addresses which you have given from time to time are most valuable to us particularly as exponents of good English. I feel that in the hurried life we lead and the desire that some workers have to get their information quickly into print, there is a tendency to neglect the form and style of our English, which, of course, as English-speaking people, we should do everything we can to prevent, and, therefore, for an additional reason your addresses are more valuable and of practical use to us as examples of the use to which English can be put. I will not detain the meeting any longer, because there may be other members who would like to say a few words of appreciation.

Prof. Lochhead: Mr. President, may I say a few words in addition to what our Chairman has said regarding the long services of Dr. Fyles in connection

with work in entomology? I have known Dr. Fyles for over twenty years; I am sorry I have not known him longer, for I might have been a better man. About twenty years ago I came into contact with a small number of men older than myself, I might say a generation older—Dr. Fyles, Dr. Bethune and Dr. Fletcher, a little younger than these two. I met them all at the Annual Meeting in London, in 1895 or 1896. These men, I think you will all have observed, have given great attention to the literary form in which they express themselves. I have said very frequently in reading over their papers (take the old Entomological Society Reports of Dr. Bethune or Dr. Fletcher, for example) that they were masters

Megarhyssa atrata ovipositing on maple, approximately natural size. Photograph by Charles Macnamara, Arnprior, Ont.

of English, and we are not keeping up to the standard they set in this respect. I agree with our Chairman that more attention should be given to the form in which our reports and papers are prepared. This is not the first paper I have heard from Dr. Fyles during all that time, for he has seldom been absent from the meetings. Then in addition, we have had him several times in attendance at our meetings of the Quebec Society for the Protection of Plants at Macdonald College. While Dr. Fyles is a strong member of the Ontario Entomolgical Society, yet I think his heart is in Quebec, where he has laboured so long. While he cannot come down to our meetings as he used to, yet we always feel that his heart is with us, and his mind and thoughts are with us at our Annual Meetings. I hope he will be able to come down for the next meeting. I rise simply to show my appreciation of the valuable work that Dr. Fyles has done in connection with the Society.

The President: I wish to make a slight alteration in the programme because of the circumstances. We have with us a gentleman from Arnprior, Mr. Macnamara, who is rapidly becoming an entomologist—in fact I think he is already an entomologist. He has been making some very interesting observations on certain insects to which Dr. Fyles referred, namely, those extraordinary hymenopterous parasites of the genus *Thalessa*. Mr. Macnamara, in addition to being an entomologist, is also a photographer of considerable skill, and has been able to apply his photographic knowledge to the recording of the oviposition of those extraordinary parasites, some of the most extraordinary parasites we have, and, therefore, I think it is rather fitting that, although I took upon myself to ask Mr. Macnamara to read this paper and it is, therefore, not in the programme as the latter had already been prepared, Mr. Macnamara should give us a brief discussion on his observations of which he has some photographs.

Mr. Macnamara: You have taken me entirely by surprise, Dr. Hewitt, and I do not think I have much of interest to say, but I have a few photographs of one of the ichneumons that the members may care to see. The prints show the male and female *Thalessa*, or as the genus is now called, "*Megarhyssa*" *atrata;* and the female alone with her extraordinary ovipositor separated to show the two sheathes and the drill. Other prints show the tree infested with Tremex which the *M. atrata* frequented, and magnified views of the ovipositor, foot and other parts are given. Perhaps the most interesting views are those of the insect in the act of ovipositing, with the flexible sheathes curved over her back.

I first observed these insects ovipositing on a maple tree in a small hardwood grove about the middle of June. They were in considerable numbers, some days twenty to twenty-five, and continued egg-laying until the middle of September when they disappeared. As their victim, the Tremex never seems to attack perfectly sound wood, *Megarhyssa* generally bores into somewhat decayed material, but it is wonderful that she should be able to drive her ovipositor as she does, to a depth of five or six inches into wood that we find hard enough to cut with a chisel or a knife.

Dr. Fyles spoke of the instinct which enables them to discover the tree tunnelled by the Tremex. Their instinct in this respect is remarkable, but by no means infallible. The *Megarhyssa* I observed frequently only on one tree in a grove of five or six acres, and frequent and careful search failed to discover them on any other tree in the wood. But in October a large maple nearby, broken off by a gale, was found to be riddled by Tremex and no *Megarhyssa* had ever discovered them.

As Dr. Hewitt has taken me entirely by surprise I hope you will excuse the crudeness of my remarks, as I have not had time to prepare anything, but probably the photographs will prove interesting to some of you.

The President: I think the photographs which are going around will prove my statement that we have with us a photographer-turned entomologist, and those of you who remember Mr. Macnamara's previous contributions to entomology in the shape of his account of the habits and some notes on the biology of those very small, little-studied creatures, *Achorutes*, will agree with me that we have a very ardent entomologist in Mr. Macnamara, and I do not think that he will need any further introduction or words to back up his election for membership when his name comes forward, as it will to-morrow.

Prof. Caesar: This photograph of Mr. Macnamara's, showing ovipositing is extremely good. It is a most wonderful thing to look at this insect ovipositing.

Time after time I have watched it and tried to get a photograph, but failed at the last moment. Might I ask that this photograph be published?

THE PRESIDENT: I agree with Professor Caesar that the publication of that photograph would be most useful.

We will now proceed to the programme. The next paper is that by Mr. Parrott and Dr. Glasgow on "The Leaf Weevil (*Polydrosus impressifrons* Gyll.) in New York."

THE LEAF-WEEVIL (*Polydrusus** *impressifrons* Gyll.) IN NEW YORK.

P. J. PARROTT AND HUGH GLASGOW.

The leaf-weevil which is discussed in this paper is a new and, until the inception of this study, an unrecorded enemy of shade and fruit trees in the United States. In view of the losses sustained by farming interests in America by introduced insects a newly-discovered species of foreign origin, however unimportant it is in its original home, is the subject of considerable speculation as well as of some apprehension until its status as a pest is definitely determined. The following notes represent a preliminary account of our studies upon the weevil, which are perhaps not without interest to those who are especially concerned in matters dealing with the introduction and spread of noxious insects.

DISCOVERY AND IDENTIFICATION OF SPECIES.

Our attention was first attracted to this species during the summer of 1906 when large numbers of the beetles were observed in young plantings of willows and poplars in the vicinity of Geneva. They were present on nearly every tree and were feeding on the margins of the more succulent leaves. Some days later specimens of the insect were sent to us by the foreman of a nursery in another part of Ontario County, N.Y., who reported that the beetles were injuring roses and apples. As the species was apparently not represented in entomological collections in this country and it was difficult to secure positive identification, specimens of the insects were forwarded to Professor Alfred Giard, The Sorbonne, Paris, and to Doctor G. Horvath, The Hungarian National Museum, Budapest, both of whom independently classified the beetle as *Polydrusus impressifrons* Gyll.

STATUS OF THE SPECIES IN EUROPE.

In view of the great numbers of the beetle in certain sections of New York, a perusal of European literature impresses strongly two points on the mind of the reader: (1) The weevil belongs to a group of insects which contain some species that are destructive, and (2) the species *impressifrons* is of little significance; and there apparently very little knowledge, if any, as regards its life history and habits—deficiencies which hold equally for some associated species that are of considerable importance, and therefore better known, at least by name. Notwithstanding the seeming lack of detailed data on life histories and habits, the weevils attacking buds and tender foliage of fruit and shade trees appear to be more injurious and varied as regards number of species in Europe than is

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*This genus is also designated *Polydrosus*, but W. D. Pierce of the U. S. Bureau of Entomology has kindly informed us that the foregoing designation is, according to the rules of nomenclature, to be preferred.

the case in this country. From the standpoint of economic status, two Otiorhynchid genera are at this time of special interest—*Phyllobius* and *Polydrusus*, which comprise a number of species of weevils that range from various shades of brown to bluish-green or golden yellow in colour. Several of these are listed as noxious insects because of their habit of nibbling young opening buds and then later attacking the foliage. With plants of horticultural importance as hosts some species also do considerable harm by gnawing the parts of the blossoms and thus preventing fructification. According to Zimmerman[1] the species of these genera are very similar in appearance and the two groups are distinguished by the character of the antennal groove. In his discussion he, however, treats the different species as a whole, considering in the following order *Phyllobius argentatus* L., *Phyl. maculicornis*, *Polydrusus sericeus* Schall, *Phyl. pyri*, L., *Poly. mollis* Stroem., *Phyl. oblongus* L., and *Phyl. viridicollis* Fabr. Aside from merely mentioning the names of the foregoing species and calling attention to errors in the writings of other authors, very little information is given as to the life histories and bionomics of the insects. It is to be noted also that *impressifrons* is not listed, an omission which would indicate that it was not of sufficient importance to be considered in an economic treatise. Judeich[2] and Nitsche mention nine species of the genus *Phyllobius* and two species of the genus *Polydrusus*, and make no reference to *impressifrons*. The also call attention to the lack of knowledge upon the different insects of the two groups. Die[3] Tierischen Feinde by Reh, which is one of the latest economic works on European insects, contains a brief account of a number of species in the genus *Phyllobius*, and states that of the numerous species in the genus *Polydrusus* only a few are so abundant as to be destructive. Four species are mentioned, but there is no reference to *impressifrons*. While Nördlinger,[4] Kaltenbach[5] and Hess[6] discuss other species in either of the two genera, none of these authors refer to the insect under discussion. In Fauna Austrica, Redtenbacher[7] gives a brief description of *impressifrons*, and states its habitat is North Germany. Jäger[8] gives its distribution as Germany and France. In 1888[9] Schilsky listed the species and states that it is plentiful throughout Germany. Turning now to England, Rye[10] in his work on Brtish Beetles lists a good number of species of the genera *Phyllobius* and *Polydrusus*, in which *impressifrons* is not definitely included. Theobald[11] in his Insect Pests of Fruit makes no reference to any species of *Polydrusus*, but discusses with some detail several Phyllobius species as *Phyl. calcaratus*, *maculicornis*, *oblongus* and *uniformis*. He states that various leaf weevils are found on all kinds of vegetation and that several species are common to not only many kinds of fruit but also to various forest trees and shrubs. Two species more prominent than others on fruit trees and bushes are the Green Leaf Weevil (*Phyl. maculicornis*) and the Oblong Leaf Weevil (*Phyl. oblongus*). The Glaucous Leaf Weevil (*Phyl. calcaratus*) is also mentioned as doing serious damage to black currant bushes. It usually occurs on alders and various low bushes and hedges. With respect to *impressifrons* Professor Theobald

[1] Zimmerman, Hugo, Die Obstbauschädlinge aus der Familie der Rüsselkäfer.
[2] Judeich, J. F., and Nitsche, H., Forstinsektenkunde, Bd. I, pp. 407-411.
[3] Reh, L., Handbuch der Pflanzenkrankheiten, Bd. 3, p. 539, 1913.
[4] Nördlinger, H., Die kleinen Feinde der Landwirthschaft, 1855.
[5] Kaltenbach, J. H., Die Pflanzenfeinde, 1874.
[6] Hess, W., Die Feinde des Obstbaues, 1892.
[7] Redtenbacher, Ludwig, Fauna Austrica, Die Käfer, Wien, 1858.
[8] Jäger, G., Käferbuch (C. G. Calwer), p. 420.
[9] Schilsky, J., Systematisches Verzeichnis der Käfer Deutschlands, 1888.
[10] Rye, Edward C., British Beetles, 1886.
[11] Theobald, F. V., Insect Pests of Fruit, 1909.

informed the senior author in 1914 that he was not familiar with it and no specimens were contained in his museum collections. As the species seemed to be more numerous in France, Austria and Germany, and desiring to know more of its present status as an injurious insect, a circular letter soliciting information on the creature was sent to a goodly number of European entomologists. The importance of the species can be judged from excerpts from two letters, one from France and one from Austria. A. Giard[12] writes that while *impressifrons* is by no means rare in the spring upon willow and alder, it is not an important species, and little is known regarding its ethology. Zimmerman[13] states that the insect is not very common in Austria or Germany and occurs on willow and alder. Injuries to the foliage of fruit trees have not so far been recorded. Little knowledge exists as to its life history and habits.

Distribution in New York.

The actual range of distribution of the beetle in the State of New York has not been determined. The insect has become established in Ontario, Monroe and Wayne counties, and scattering numbers of the species have been captured as far west as Albion, in Orleans county. It is not improbable that the species occurs over a larger territory than has been indicated.

Food Plants.

The beetle is apparently an omnivorous feeder, subsisting on the foliage of a large number of plants, among which there may be listed birch, willow, poplar, apple and pear as its favorite plants. Scattering individuals have been collected at various times on elm, rose, linden and black locust, which seemingly were feeding on these plants, although their presence on them may have been accidental and due to the close proximity of more attractive plants. While specimens of the beetles, either actively engaged in feeding or in copulation have been observed on all of the above plants, it should be noted that none or very few of the insects have been seen on maple, box elder, horse chestnut, lilac, syringa or elderberry, although these were growing in considerable numbers near the preferred hosts.

To determine more closely the preferences of *impressifrons*, beatings were made of different plants, and from the collections obtained it appears that the insects seek birches, willows and poplars in the greatest numbers, and, if the beetle manifests any choice among these, preference is given to birches. In feeding tests in breeding cages the creatures subsisted on the foliage of these plants as well as of pear with no apparent choice, and selected the foliage of the foregoing trees in preference to that of the apple.

Siftings of earth showed that the insect breeds in large numbers on such varieties as the Pussy Willow (*Salix discolor*), the Kilmarnock Willow (*Salix pendula*), the Laurel-Leaf Willow (*Salix petandra*), the Weeping Willow (*Salix babylonica*), the Wisconsin Willow (*Salix dolorosa*), and the White Willow (*Salix alba*). Larvæ in great abundance were similarly obtained in soil about two species of birch (*Betula populifolia* and *alba*) and the Carolina and Lombardy poplars (*Populus deltoides*, var. *carolinensis* and *P. nigra*, var. *italica*).

[12] Giard, A., Letter of July 7, 1906.
[13] Zimmerman, W., Letter of Aug. 7, 1910.

CHARACTER OF INJURY.

As is the case with many associated species in Europe, the damage that *impressifrons* causes is two-fold: First, it nibbles the unfolding buds and then it attacks the foliage, preferring the margins of the leaves. The beetles, while small in size, are voracious eaters, and the extent of their injury is, broadly speaking, in proportion to their abundance. Many of them confined to a relatively small feeding area may cause much harm. The numbers of the insect that one may sometimes observe would suggest at once that they must be doing appreciable damage. However, it should be recorded that generally the extent of injury seems to be greatly disproportionate to the numbers of the creatures. The most conspicuous example of their destructive capacity was observed in 1912 in a large block of willows in a nursery plantation. This was largely composed of the goat willow (*Salix caprea*) grafted to such sorts as New American, Rosemary and Kilmarnock. The latter variety particularly suffered severely as a great many of the insects attacked the opening buds, so that a goodly percentage of them were killed while those partially injured produced imperfect clusters of leaves. The initial injuries were later aggravated by the feeding of the beetles on the margins of the leaves. The effect of this latter attack is to cause the leaves to have an uneven outline, and in instances of extreme injury to present a ragged appearance. So abundant has the insect become in the certain nurseries that the owners have found it necessary to resort to spraying in order to protect their willow plantings. So far we have observed no injuries by the beetle to buds of poplar, birch, apple or pear, and while feeding to an important extent has not been detected on these trees, an examination of them during June will seldom fail to find the work of the insect on the margins of the leaves. At present *impressifrons* derives it importance as a pest from its destructive work in nurseries. In some plantings where it has become established it is very numerous and will hardly fail to attract the attention of an ordinary observer. There is no other species of snout-beetle that, during its active period, so frequently brings itself to your notice. It is not an uncommon experience to carry the beetles on one's clothes into the home or to observe them on the window screens of buildings. The foreman of one well-known nursery has informed us that aside from the damage sustained the beetles have become so abundant in plantings of poplar, birch and willow that they are a source of great annoyance to laborers by flying in their faces. The abundance of the insect is indicated by the following counts: From a sample of earth about osier willow two feet square and to the depth of the spade, ninety-two larvæ were collected. From three spadefuls of earth taken near the base of different kinds of nursery trees the following numbers of larvæ respectively were found: Carolina poplar, 27 specimens; Lombardy poplar, 12 specimens; silver-leaf poplar, 12 specimens; birch, 25 specimens; willow, 19 specimens; American mountain-ash, 17 specimens; European mountain-ash, 1 specimen; apple, old tree in sod, 1 specimen. A similar quantity of earth, three spadefuls, taken about five-year-old fruit trees in a mixed planting yielded the following numbers of insects respectively: apple, 65 specimens; pear, 51 specimens; peach, 35 specimens, and plum 62 specimens. One corner of this orchard was only a little removed from a row of osier willow. The fact that *impressifrons* is apparently of little significance abroad certainly does not warrant the conclusion that it will prove of no importance in this country. The conditions described justify the inference that the species is already more abundant and injurious here than in Europe or more attention would surely have been devoted to it there.

Life History and Habits.

The beetles emerge from the ground during the latter part of May and early June. In 1914, they were first detected on May 26, and during the next few days they were mating freely on the foliage. By May 30, eggs were being deposited. For the reception of the eggs the insect seeks cracks or crevices in the bark, such as spaces that occur when the bark is loose at stubbed ends of twigs or branches. Loosened bud scales on twigs or wood, which have been removed by pruning and allowed to remain on the ground, are also sought by the creatures for the deposition of eggs. They appear to select any dry cavity in which the eggs may be inserted, and which occupy positions that are exposed to the sunlight. Eggs have been observed in situations on trees that were ten feet from the ground, and doubtless they will be found in higher positions. The egg measures about .2 mm. in width and .5 mm. in length. It is white, cylindrical and gently rounded at the ends. Its shape seems to be influenced by the accommodation of the egg to surrounding surfaces. Eggs occur singly or in masses, but usually in groups containing from twenty to eighty-five of them. Oviposition is most active during early June. The period of incubation averaged between twelve and thirteen days with little variation under ordinary conditions. Upon hatching the young larva wriggles out of its position of concealment in the bark and falls to the ground. It then seeks a crack in the earth, when it quickly disappears. The larvæ apparently feed on tender roots, and our observations indicate that they can live exclusively on the roots of willow, poplar and birch. Doubtless they find subsistence on the root systems of other trees. It has not been determined that they can live on the subterranean parts of grasses or weeds which may be growing about the foregoing plants. The larvæ transform to pupæ during the latter part of April and early May. The pupal cells are considerably larger than the larvæ and are at an average depth of about two inches, although some of them may be three inches in the soil.

Methods of Control.

The beetles are quite susceptible to arsenical poisons, and should it become necessary to combat them little or no modification will probably be required in existing spraying practices. Cultivation, if done with care and at the proper time, would doubtless prove very destructive to both larvæ and pupæ in the soil.

The President: The State of New York certainly is a general stamping ground for new pests. We have the *Hyponomeuta,* and now we have this other *Polydrusus* which evidently by its abundance seems to be firmly established in that State. I do not remember whether you mentioned in the paper any suggestion as to how it came in.

Dr. Glasgow: We cannot say with certainty, but probably in earth about the roots of nursery stock. This is the only way apparently that it could get in.

Mr. Burgess: I would like to ask Dr. Glasgow what success he has had in its control.

Dr. Glasgow: It is very readily controlled by arsenical poisons.

Mr. Burgess: Do you use arsenate of lead?

Dr. Glasgow: Yes.

Mr. Burgess: At what strength do you use it?

Dr. Glasgow: Commonly at the rate of three or four pounds of the poison to fifty gallons of water.

Father Leopold: At what time of the year do you use arsenate of lead?

Dr. Glasgow: About the last of May or early in June, or whenever the beetle becomes abundant to warrant treatment.

The President: If there is no further discussion we will proceed to the next paper, which is of great interest, by Professor Brittain, on "*Lygus invitus* and its control in 1915."

THE GREEN APPLE BUG (*Lygus invitus* Say.) IN NOVA SCOTIA.

W. H. Brittain, Provincial Entomologist for Nova Scotia.

History.

For a number of years past certain fruit-growers in the Annapolis Valley have complained of the non-bearing of their Nonpareil trees. These trees would bloom heavily each year, but would never bear anything like a full crop, yielding only a few gnarled apples; or, in many cases, none at all. This trouble was not entirely confined to Nonpareils, but was more pronounced and by far the most common in this variety. Others complained that their pears "grew woody" and were covered with corky, disfiguring scars. This latter trouble was commonly ascribed to lack of iron in the soil, and liberal applications of iron filings were frequently applied to correct this condition. Driving nails or spikes into trees was also practised.

No one appears to have suspected that there was any connection between the apple and pear trouble, or that either was caused by an insect. In June, 1914, the writer visited an orchard consisting of mature Nonpareils, Ribstons, Gravensteins, Golden Russets and several varieties of pears. The owner stated that the Nonpareils had not had a crop for at least six years, and that the trouble was gradually spreading to the other varieties. Furthermore, the pears were so badly affected that a number of them had been cut down. The affected trees were swarming with the green nymphs of *Lygus invitus*, and it took very little observation to show that they were the culprits. Following this, many reports of similar damage to apples and pears were followed up with a like result, and further investigations have only tended to confirm our early observations.

Distribution and Spread.

The pest seems to be well distributed throughout the fruit-growing centres of Nova Scotia, including the counties of Hants, Kings, Annapolis and Digby. It seems to be more widely distributed on the pears than on the apples, the phrase "injury to pears only" occurring with considerable frequency in the reports of the entomological inspectors.

Though experiment has shown that the adults are capable of flying considerable distances, as a matter of fact, the pest spreads only slowly from orchard to orchard. One orchard immediately across the road from a very heavily infested one, showed few signs of injury. The amount of damage to pears does not seem to vary much from year to year, but the injury to apples appears to be on the increase in many localities and spreading from the more susceptible to the less susceptible varieties.

Seriousness of the Pest.

Sufficient has already been written to indicate that this insect is a very serious pest of both the apple and pear, but any estimate of the actual damage done would, of course, be out of the question. However, it is safe to say that it is one of the most serious insect pests of our orchards. In fact, there can be no doubt that in orchards where it has become established, we have no pest to compare with it, either in amount of damage done or in the difficulty of eradication. The pears in certain orchards have for years been so scarred as to be scarcely merchantable, and, in not a few apple orchards, the crop of fruit from susceptible varieties has been greatly reduced or even destroyed. In one orchard visited, only one apple could be found among ten large Nonpareil trees, due entirely to the work of the Green Apple Bug.

Host Plants.

As far as we have determined, the insect only breeds in the apple and pear. It has been found feeding in the adult stage on plums, but has not been known to oviposit in that plant. When shaken from the trees the nymphs have been observed to feed upon couch grass, timothy, red clover, dandelions and other plants growing beneath the tree, but on reaching the adult stage they again seek the apple and pear trees for the purpose of feeding and depositing their eggs.

The Insects.

When the insect first appears it is light yellow in color, but as it develops it becomes green. It somewhat resembles an aphis in appearance and was once described by a farmer as a "new kind of long-legged aphis." Others speak of it as the "horned aphis" on account of its long antennæ. The adult is a small, delicate insect, one quarter of an inch long. It is very pale on first emerging, but later becomes a combination of light and dark brown. In appearance it resembles quite closely the Tarnished Plant Bug (*Lygus pratensis*).

Life History.

The maximum emergence of the nymphs from the egg state coincides with the opening of the blossoms of the Gravenstein apple, but the beginning of the emergence is about five or six days earlier. They continue to hatch until the time the blossom petals fall, when emergence is practically finished. In the season of 1915 the first nymph to emerge was taken on May 24th and the last on June 10, the period of maximum emergence being from June 1st to June 5th. The duration of the first nymphal instar is 5.22 days (average of 52 individuals); of second, 5.43 days (average of 34 individuals); of the third, 6.66 days (average of 34 individuals); of the fourth, 6.77 days (average of 24 individuals); and of the fifth, 6.83 days (average of 12 individuals).

No nymphs were observed during the past summer after July 7th, all having completed their transformations by that date. The length of the adult stage varies greatly, single individuals having been taken in the orchard as late as the first week in October.

The following table gives the details of the life history of twelve individuals, which were reared from the egg to the adult stage:—

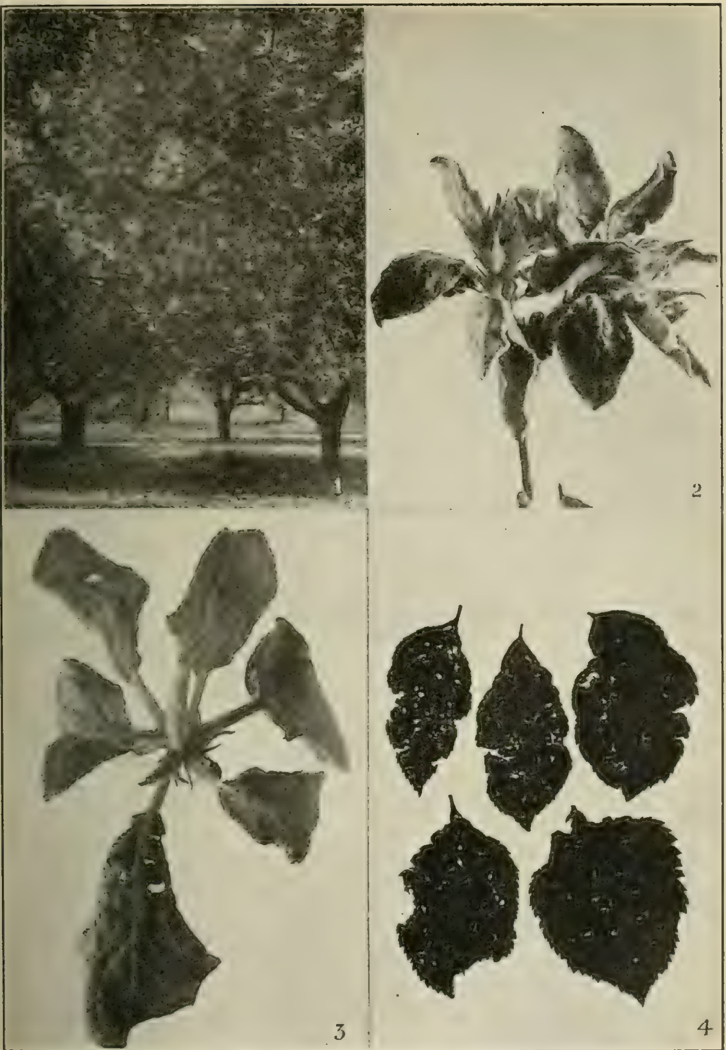


PLATE I.—*Lygus invitus.*

Fig. 1.—Orchard heavily infested with Lygus. Note thickness of the trees.

Fig. 2.—State of buds when first bug was found in the spring.

Fig. 3.—Injury to young leaves.

Fig. 4.—Appearance of mature leaves, that have been punctured while young, when held to the light.

LIFE HISTORY OF LYGUS INVITUS IN 1915.

No. of insect.	Date of hatching.	Date of 1st moult.	Date of 2nd moult.	Date of 3rd moult.	Date of 4th moult.	Date of 5th moult.	Date of death.	Number of days spent in each Nymphal instar.						Duration of adult stage.	Total length of life.
								1st instar.	2nd instar.	3rd instar.	4th instar.	5th instar.	Duration of nymphal stage.		
													Days.	Days.	Days.
1......	June 1	June 6	June 13	June 20	June 27	July 4	July 8	5	7	7	7	7	33	4	38
2......	" 2	" 7	" 11	" 18	" 26	" 3	" 4	5	4	7	8	7	31	1	33
5......	" 4	" 8	" 15	" 22	" 29	" 6	" 10	4	7	7	7	7	32	4	36
11......	" 4	" 10	" 16	" 22	" 29	" 6	" 13	6	6	6	7	7	32	7	39
17......	" 2	" 6	" 13	" 20	" 28	" 5	" 10	4	7	7	8	7	31	5	38
19......	" 3	" 8	" 15	" 23	" 30	" 7	" 11	5	7	8	7	7	34	4	38
22......	May 31	" 4	" 10	" 17	" 25	" 2	" 9	4	6	7	8	7	32	7	39
23......	June 2	" 7	" 13	" 20	" 26	" 2	" 8	5	6	7	6	6	30	6	36
27......	" 2	" 7	" 12	" 19	" 26	" 4	" 9	5	5	7	7	8	32	5	37
31......	" 3	" 9	" 16	" 22	" 28	" 5	" 14	6	7	6	6	7	32	9	41
33......	" 1	" 7	" 15	" 21	" 29	" 4	" 12	6	8	6	8	5	33	8	41
34......	" 3	" 9	" 16	" 21	" 28	" 5	" 10	6	7	5	7	7	32	5	37
						Averages		5.08	6.41	6.66	7.16	6.83	32	5.41	37.75

The duration of the nymphal stage in our open air insectary corresponds closely with that in the orchard, as proved by extensive observations, but the life of the adult insect under natural conditions is much longer than the insectary records would seem to indicate. Repeated experiments show that the adults will not thrive in confinement, but keep flying restlessly about, until they die of exhaustion. For the first week or ten days after emerging the adults were abundant in the orchard, but after that they began to die off quite rapidly. It was an easy matter during this time to find a number of dead bugs fastened along the midrib of a single apple leaf. The bugs have a habit, when about to die, of extruding the caudal extremity of the alimentary canal, which is covered by a viscid secretion, by means of which they attach themselves to the leaf.

Though large numbers of bugs died during the latter part of July, there was no difficulty in finding specimens through the month of August and early September. After that individual specimens could only be located with difficulty. On August 27th 50 adults were collected, 46 being females and four males; on August 30th, 50 more were collected, 45 females and five males; on September 3rd, collected 31 specimens, 27 females and four males; September 9th, 10 insects collected, all females, September 13th, 10 more specimens, all females, and on September 17th only two adult females could be found. From that date until October 7th scattering female specimens have been taken.

Oviposition.

The eggs are laid beneath the tender bark of pears and apples, principally the latter. All attempts to catch the female in the act of oviposition were fruitless, though many hundreds of females were brought into the laboratory and placed on apple and pear limbs, or upon apple seedlings beneath jars or wire frames. In no case was the female observed to oviposit, but after flying around for a few days dropped to the ground and died. Neither were we able to make any observations on this point in the orchard, owing to the extreme shyness of the adult insect, and to the almost continuous wet weather that prevailed at that time. Eggs were found beneath the bark on July 20th and several times subsequent to that date, which agreed in every respect with those dissected from the female insect.

H. H. Knight,* who observed one female of *Lygus invitus* in the act of oviposition, writes of it in these words:—

> The female observed to oviposit was first discovered when the ovipositor was inserted nearly to its base in a fresh pear shoot of the present year's growth. After two minutes the ovipositor was withdrawn. The female turned, inspected the hole, then moved along the branch about two inches. After five minutes she became very active and proceeded along the branch feeling with antennae and beak. She soon returned to the spot where eggs had been placed before, and, with proboscis to mark the opening, she raised up, unsheathed the ovipositor, and made the insertion much in the same manner as observed in the case of apple red bugs. A period of two minutes elapsed before the ovipositor was withdrawn. Upon examining the branch, it was found that six eggs had been laid in a space 1 mm. long. The eggs were closely packed in a double row lying flat just within the cambium layer. Of two eggs measured, the length is 1.05 mm. by 26 mm. wide.

Habits of Nymphs.

The nymphs of this insect are extremely elusive in their habits, which probably explains the fact that, though their injury has been known for many years, they themselves have never been connected with it until the present time. When

*Jour. of Economic Entomology, Vol. 8, No. 2, pp. 296-297.

disturbed they run rapidly, hiding in the axils of the leaves or any place that affords concealment. When disturbed suddenly, they often drop, but usually alight on another branch before reaching the ground. In cases where nymphs fallen to the ground have been prevented from reascending the tree, by means of tanglefoot bands, beneath which they cluster, it has been observed that when a person suddenly approaches the tree, a number of them will drop to the ground. Others have been observed to drop in this way when approached by an enemy or harvestman.

The young nymphs seem to prefer the young foliage of apple and pear, but will also puncture the tender shoots. Later they freely attack the blossoms, but they forsake all other food for the fruit once it has set. Though we have reared through these insects exclusively on leaves, there is no doubt that the later nymphal stages prefer fruit, and they can only with difficulty be induced to feed on mature leaves. A favorite place to feed is a cluster of fruit growing closely together and not having reached the size when their own weight pulls the separate fruits apart. In feeding, the nymphs range quite widely over the tree, especially when not numerous. Every fruit on a very lightly infested pear tree was pierced several times, showing that several must have been punctured by one insect. This observation was further confirmed by liberating a number of nymphs beneath a non-infested tree. The next day the typical injury was present all over the tree. The nymphs were observed to exhibit predaceous habits on several occasions. At one time a number of bugs were observed repeatedly thrusting their beaks into three larvæ of the green fruit worm (*Xylina* sp.) that had become caught in a tanglefoot band, and continued to do so until the caterpillars had been sucked completely dry. They will also on occasions attack man. The writer has been stung in the neck and hand more than once. If left alone the insect will pierce the skin of the hand as many as three times and remain feeding until gorged with blood.

Habits of Adults.

The adults, like the nymphs, are very active. On bright, sunny days they usually take to flight very readily when disturbed. On dull, cold days they are more sluggish and sometimes drop to the ground, though often they take to flight after having dropped a short distance. On really hot days the adults fly about considerably, and, standing in a heavily infested orchard, they can be readily observed flying about in the sunlight.

Since the prevailing opinion is that the pest spreads but slowly in an orchard, experiments were tried to determine the length of flight of the adults. When liberated the insects fly straight up in the air for a considerable distance, after which they can be followed by the eye for several yards, as they fly straight off in one direction. Just how far they fly at any one time it would be difficult to determine, but individuals have been taken one quarter of a mile from the point of liberation, a few days later.

Like the nymph, the adult may also become predaceous in habit. The writer observed one with beak inserted full length in a tussock moth larva, and it relinquished its hold very reluctantly. It will also pierce the skin of man quite as readily as the nymph.

The adult Lygus will not feed upon foliage at all readily, preferring a diet of fruit, and, unlike the nymph, which seems to prefer the apple, the adult seems to have a preference for the fruit of pears. One case was observed in which a row of pear trees had been freed of nymphs by spraying. Adjoining this row was a number of infested apple trees, and as soon as the bugs developed wings, they flew over

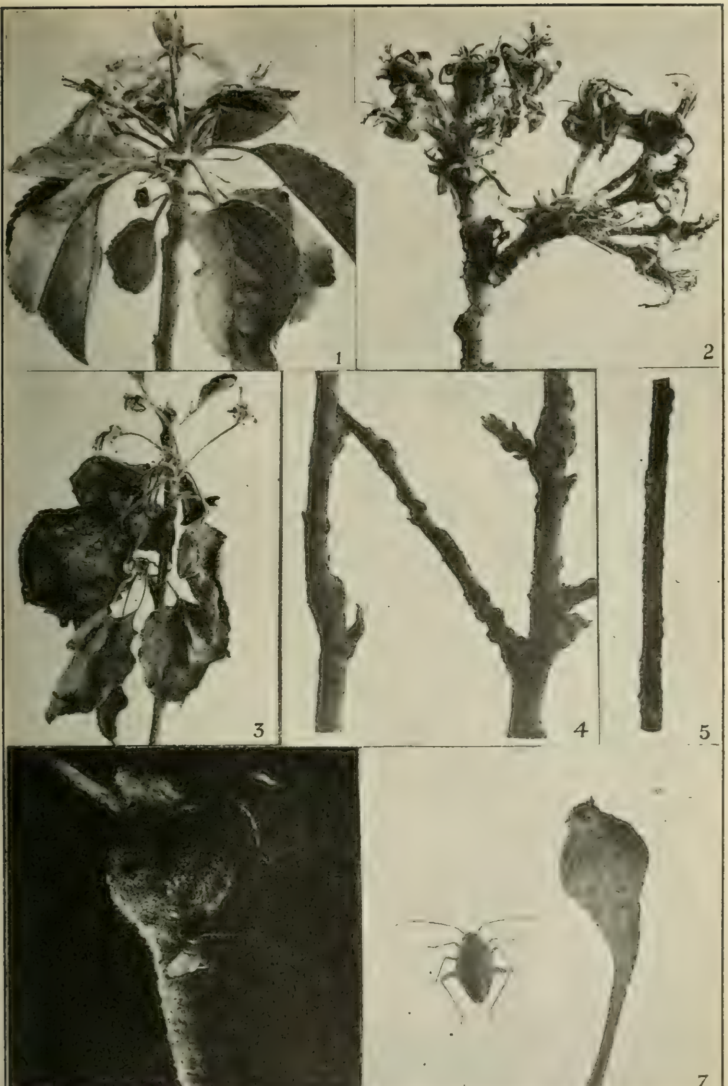


Plate II.—*Lygus invitus.*

Fig. 1.—Injury to blossoms.

Fig. 2.—Final condition of injured blossoms.

Fig. 3.—Blossoms and twigs killed by repeated punctures.

Figs. 4 and 5.—Twig punctures.

Fig. 6.—Nymph at work on a young apple.

Fig. 7.—Fifth stage nymph and young pear, showing effect of punctures.

and pierced the pears till they were bathed in the sap that oozed from the punctures. In the laboratory, adults have left a fairly ripe, soft apple to feed upon a hard green pear. All through the season a favorite place for the bugs to feed is about clusters of apples that have been dwarfed by the Rosy Aphis, and here the adults can be found, when nowhere else, late in the season. These belated individuals also show a preference for over-ripe or even decaying fruit.

Character and Extent of Injury.

1. Injury to the Apple.—The first evidence of injury is to the tender foliage in the form of purplish spots upon the surface of the leaf, accompanied, in severe cases, by a slight tendency to curl. To one who is familiar with the work of this insect, this symptom is most characteristic and makes it possible to detect the presence of the nymphs at a very early stage, and even when they are present in small numbers. Six newly hatched nymphs were placed on an apple seedling in the laboratory, and twenty-four hours later every leaf was spotted with the typical purplish markings. As the leaves unfold and later reach full size, the discoloration disappears, but if affected leaves are held up to the light they will appear to be pierced through and through with tiny holes. Very severe attacks result in a ragged, frayed appearance of the leaf. By these symptoms, the former presence of the bugs on any tree can be detected long after they have completed their transformation and disappeared.

The tender, succulent twigs are also subject to attack, and as the insect withdraws its beak a drop of clear or amber sap oozes through the bark, marking the puncture. Later, as the twig increases in size, quite a decided lump may develop at the point of puncture, accompanied in severe cases by a longitudinal crack.

In heavily infested orchards, where the insect may be present in tens of thousands, the repeated puncturing and withdrawing of the sap goes so far that affected twigs wilt, the leaves become brown and dry, and finally the whole shoot dies. Cases where many of the twigs were literally stung to death in this way were quite common early in the summer. Later the dead twigs dropped off and were replaced by a strong new growth, which covered up the injury done by the bugs.

As the blossom petals appear and begin to unfold they are quickly attacked by the young nymphs, which have been frequently observed right inside a blossom with beak inserted in the pistil. In fact, so numerous were the insects and so persistent their attacks that the blossoms and the blossom pedicels wither and die, having been sucked quite dry by the nymphs. These dead and dry blossoms remain on the tree for some time, but break off and fall to the ground before the end of the season. These facts explain why susceptible varieties may come into bloom year after year but never set a crop of fruit.

As soon as the young fruit is formed, drops of gum oozing through the skin show that it also has been punctured by the insect. Later, slightly raised, discolored spots mark the injury, and a large proportion of fruit so injured drops to the ground in the course of a few days. Apples that are able to cling to the tree or that remain uninjured until later on in their life, are badly gnarled and misshapen as a result of the insect's attack. The tissue above the puncture fails to develop and, as a result of the uneven growth, the apple will be one-sided with a pronounced depression about the point of puncture, which itself is marked by a brown, corky scar with ruptured epidermis.

2. Injury to Pears.—Injury to the leaves, stems and blossoms of the pear resembles that of apple, except that in this case the tissue about the puncture

turns black. Stinging of the young pears does not often result in dropping, as in the case of apples. The effect of the punctures on the fruit is, however, very conspicuous, it being covered with hard, granular, corky scars, which are often split open as in the case of those on the apple. Hard, flinty areas extend into the pulp, making the fruit useless for any purpose whatever.

3. Injury to Plum.—Injury to the fruit of plums is not uncommon, where these trees border on affected apples or pears. Plums injured by the bugs do not usually become scarred and twisted, as in the case of apples and pears, though they may sometimes grow somewhat one-sided. The seat of the injury is usually at the extremity of the fruit furthest from the stem. As usual in the case of stone fruits this injury is marked by the exudation of colorless gum which flows through the small puncture, sometimes forming a globule and sometimes a coil of gum which finally hardens in the air.

Feeding Experiments.

In affected orchards large numbers of nymphs are frequently shaken to the ground by sprays, heavy rains, winds, etc., and in numerous instances these were observed feeding upon dandelions, couch grass, red clover, and other plants at the base of the tree. Even when forced to feed on these plants early in the nymphal life the insects seemed to be able to complete their transformations, but once they had obtained their wings, they invariably sought the fruit of the apple or pear.

A number of nymphs in their second or third instars were divided into lots of ten and confined upon a number of plants under cheesecloth bags. The following observations were made:—

Grape (*Vitis* sp.).—The nymphs feed readily upon grape, puncturing leaves and blossom clusters. The tissue surrounding the punctures turns black.

Elm (*Ulmus americana*).—The injury to the foliage of the elm was quite noticeable in dark colored spots, but there was no apparent puncturing of the twigs.

Maple (*Acer saccharum*).—The injury to maple leaves was slight. The injury was characterized by small translucent spots.

Sweet Cherry (*Prunus avium*).—Slight puncturing of leaves and blossoms, but little apparent injury.

Peach (*Prunus persica*).—The leaves showed visible punctures and were slightly curled. Small globules of transparent gum showed where the fruit had been punctured.

Red Clover (*Trifolium repens*).—Transparent areas on the leaf accompanied by a gradual fading and wilting of the plant, characterized the injury to red clover.

Strawberry (*Fragaria chiloensis*).—Strawberries showed evidence of more serious injury than any of the plants experimented with. Blossoms and leaves were so badly punctured that they finally withered and died.

Couch Grass (*Agropyron repens*).—The blades of couch grass were punctured quite severely, fading in color and showing other evidence of wilting.

Susceptibility of Varieties.

Extensive observations regarding the susceptibility of varieties reveals the fact that of all varieties of apples the Nonpareil is by far the most liable to attack. In many orchards it is only the trees of this variety that appear to suffer at all. Cases have been observed in which badly attacked Nonpareil trees were surrounded

by trees of other varieties apparently untouched. Nevertheless, it seems to be true that in most cases the bug will gradually enlarge its field of operation from the more to the less susceptible sorts. Fruit-growers tell of numberless instances where the trouble began in their Nonpareil and gradually spread to their other trees. The following varieties show susceptibility in the order named:—Ribston, Gravenstein, Golden Russet, Blenheim, Baldwin and Greening.

Among the varieties of pears attacked the Bartlett shows the highest degree of susceptibility. So much is this the case, that some have regarded the trouble as a disease of this variety. Other susceptible varieties are Clapps' Favorite, Burbridge, Maria and Flemish Beauty. Varieties not so susceptible are Louis Bonne, Bosc, Lawrence, Duchess and D'Anjou.

Conditions Favoring Increase.

It is difficult to state definitely under what condition this insect flourishes best, since it is found in orchards treated in every conceivable way. Sprayed and unsprayed, clean cultivated and sod, well cared for and neglected orchards are all attacked. It is a notable fact that some of the very worst infestations are in orchards that have received the best of treatment in the way of spraying, fertilization and tilth. In most cases, however, such orchards were unduly shaded, insufficiently pruned, or too thickly planted. In two very bad cases the orchard was cultivated on the strip system, i.e., a strip of clover sod alternated with a clean cultivated strip. In another case the orchard was part cultivated, part in sod. Here the trees in sod seemed to show the greatest evidence of injury, but the difference was not readily detected. On the whole orchards with a thrifty, succulent growth seemed to suffer most.

As a result of all our observations throughout the infested area, it appears that the most suitable conditions for the undue increase of this pest are shady orchards with closely planted, thick growing trees, with a certain amount of herbage at their base, but for the most part thrifty and vigorous in other respects. Nevertheless, these factors are not essential, as the insect is capable of doing injury under a wide range of conditions.

Natural Enemies.

Ants seem to be the only natural enemies that exert any appreciable influence on the control of this pest. These have been frequently noticed carrying away nymphs on their jaws. On one occasion, when a number of nymphs were liberated at the base of the tree, four of them were seized by as many ants and carried off through the grass to the ant hill, which was distant fifteen feet from the tree. Spiders also destroy a certain number of nymphs, but it is questionable whether ants or spiders ever kill enough nymphs to noticeably reduce their numbers. The ant responsible for this work was determined by Dr. Wheeler as *Formica fusca*.

Control Experiments.

Control experiments were carried on under most unfavorable conditions this spring, the weather being almost continuously wet. This made it very difficult to apply the spray at the proper time or to observe its effect upon the insect. Two orchards were chosen, containing a large number of mature apple and pear trees of the susceptible varieties.

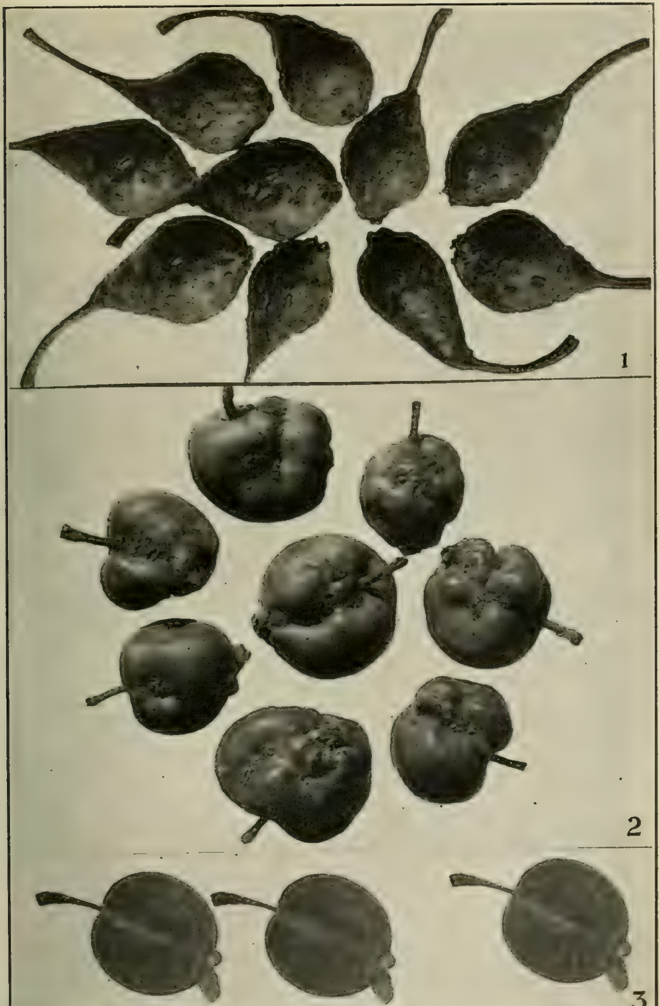


PLATE III.—*Lygus invitus.*

Fig. 1.—Injured pears.
Fig. 2.—Injured apples.
Fig. 3.—Injured plums.

Blackleaf 40, 1 pint, $1\frac{1}{2}$ or 2 pints to 100 gallons was used both alone and with soap, and also in combination with lime-sulphur. One spray was put on just before the blossoms opened, with another just after the blossoms fell, for the apples. Another block was sprayed in full bloom. Pears were sprayed just after their blossoms fell and again five days later.

Examination of trees directly after spraying showed them to be apparently free from insects, and large numbers of dead nymphs would be found stuck to the leaves by their caudal extremities in the characteristic fashion. Examined two days later, though the block sprayed in full bloom seemed to show best results, all the trees were found to be covered with bugs. As laboratory experiments had shown that the material used was quite effective in killing the insect when hit by the spray, even when the weakest strength was used, we knew that the trouble was not in the strength of the spray, or in the manner of its application.

Observations taken in the sprayed orchards showed large numbers of nymphs ascending the tree trunks. Even in unsprayed orchards it would appear that large numbers of nymphs fall to the ground, shaken off by the high wind or washed off by the heavy rains. Insects were found in abundance beneath the trees in such orchards or climbing up the trunks.

In order to determine to what extent nymphs were washed off during spraying and whether any considerable proportion of these succeeded in reascending the tree, one large tree was sprayed thoroughly with Blackleaf 40 and soap, after having been banded with tree tanglefoot 3 feet from the ground. Shortly after spraying the trunk of the tree beneath the band was green with nymphs. These were counted and removed each day for seven days, and at the end of that time the total number of insects captured beneath the band reached the total of 1,389. Large numbers, of course, went up adjacent trees, 538 being taken from one of these. It should be noted here, that this number represents but a very small proportion of the insects originally on the tree. By far the greater number were killed and their dead bodies could be found in abundance sticking to the leaves or on the ground. Nevertheless, where so many thousands were present they were sufficient in number to sting every fruit on the tree and so destroy the crop.

To determine whether the effect of the spray was merely mechanical or whether the insects that fell were partially overcome by the spray material, another tree was given a strong spray of water with a drive nozzle and at a pressure of 200 pounds. In this case the total for seven days was 308. This shows that there was something beside the mechanical effect responsible for the large drop from the sprayed tree. This may be due to the insects being hit by the spray, but not sufficiently covered to cause death. Again, it may be that the effect of the nicotine fumes is to make the nymphs relax their hold and drop to the ground. Laboratory experiments have shown that the fumes of the spray material alone are sufficient to cause death. Nymphs were placed on apple seedlings in cages and at the base was placed cotton wool soaked in Blackleaf 40 at the regular strength. The next day the nymphs were dead.

Experiments were made to determine the distance the nymphs were able to travel and reascend the tree. In an orchard that had not been cultivated for several days, four trees 30 ft. apart each way were banded and 300 nymphs liberated midway between them. The next day 17 insects were taken from beneath the tanglefoot band. A similar experiment was tried with 150 bugs in an orchard that had just been thoroughly cultivated. In this case 19 insects reached the trees. The same experiment was repeated in an orchard that was in sod and 300 nymphs liberated. In this case none reached the tree, but could be seen feeding freely

upon the grass and clover. That the nymphs do travel through a sod orchard, however, is shown by the fact that a number were taken from a young tree of the current season's planting, placed midway between two trees thirty-five feet apart.

It was evident from the foregoing experiments that, in addition to spraying, some method must be devised to prevent the nymphs that fall to the ground from reascending the tree, and continuing their injury. Accordingly, another block of trees was sprayed, some of which were banded with the tanglefoot and others not. Subsequent examination showed that the unbanded trees showed insects in abundance, while on the banded ones it was almost impossible to find a single nymph. Experiments showed also that a thorough harrowing after spraying had the same effect as banding. Of all the unbanded trees, those sprayed in full bloom showed the least injury, but even on these trees the fruit was so badly scarred as to be practically worthless.

Another difficulty arose in this connection, viz., that the nymphs are capable of feeding and coming to maturity on grass or weeds growing beneath the trees. Cases occurred in which fruit which had been kept clean by spraying was rendered worthless by adults flying in from outside. For this reason, if this pest is to be controlled, the orchard must be kept under a system of clean cultivation until the end of the first week in July.

The control of the Green Apple Bug in Nova Scotia sets a new precedent in heavy spraying in that Province. Furthermore, the method of planting and heading frequently does not lend itself to the kind of spraying required. The trees are frequently very large, headed very high and planted very thickly, so that it is impossible to get through the rows with a tower on the machine, which is the only way that the tops can be reached. Furthermore, the trees are often very thick-headed, so that even with other conditions favorable, it is a matter of very great difficulty to hit every insect with the spray, and attempts to control the pest in such trees is certain to result in failure. All the foregoing facts must be kept in mind if this pest is to be eradicated from the orchard.

Summary.

The observations and experiments of the past season may therefore be summarized as follows:—

1. The Green Apple Bug is one of the most serious pests of apples and pears in Nova Scotia, though hitherto, owing to its elusive habits, it has not been recognized as such.

2. It is the cause of "woody pears" and one of the causes of gnarled, twisted apples. It is the most common cause of the continued failure to bear of Nonpareil and certain other varieties of apple. It attacks not only the fruit but also the foliage, stems, and blossoms of apples and pears, and in the adult state has been known to attack plums.

3. The nymphs are frequently caused to drop from the trees by high winds, heavy rains, sprays, etc., and may then either reascend the tree or feed upon the weeds, grass or clover at its base.

4. Though capable of coming to maturity on the foregoing plants, in the adult state they invariably seek the apple and pear to deposit their eggs.

5. In control, not only must the tree be thoroughly sprayed to kill as many bugs as possible, but those which have fallen to the ground must be kept there without food until they starve. If the orchard is in sod, or weeds are abundant, the insects on reaching the adult state, will fly to the trees and continue their work.

6. The orchard must, therefore, be kept in a state of clean cultivation, until all the insects have reached the adult state, which will be at the end of the first week in July.

7. The trees must be banded with tree tanglefoot to prevent the reascent of the insects that have fallen to the ground.

8. The trees must be properly pruned, so that all parts can be readily reached by the spray.

9. Apple trees should be sprayed with Blackleaf 40 in the strength of 1 pint to 100 gallons, just before the blossoms open and again after they fall; pear trees just after the blossom petals fall and again five days later.

10. A very heavy, drenching spray must be applied.

11. The insects are much more easily controlled on pears than on apples so that with light infestations in this tree, spraying alone should be sufficient to control the pest.

Conclusion.

The foregoing is only a summary of a single season's work. New facts will doubtless be revealed by subsequent study. The work was carried on under considerable difficulties, the pest being a new one and little known regarding its habits. The methods of control which have been given require considerable care in their application, but once the pest is eradicated it should not be so troublesome to prevent further serious infestations. The great need at the present time is an insecticide cheaper than Blackleaf 40, that will do the work as effectively. However, even under present conditions, growers who have lost entire crops from the work of this pest will not hesitate to take the measures recommended.

The President: Professor Brittain is to be congratulated on the amount of work he has accomplished in a single season, and also the extent of his work. I myself have noticed the corky pears in Nova Scotia, but I never performed the crucial experiments which induced Professor Brittain to undertake the eradication of the pest. I can personally testify to the extraordinary damage which is now being caused by this insect throughout Nova Scotia. I was down there about three weeks ago and was able to see the results of the damage. I was also able to appreciate the extent to which the fruit-growers in the Annapolis Valley are grateful to Prof. Brittain for discovering the cause of these corky pears and the cause of the injuries on the Nonpareil trees. I know there are a number of members here who wish to ask Professor Brittain questions, and the paper is now open for discussion.

Prof. Caesar: On account of the similarity of this paper to the next I think the discussion of this paper should be postponed until after the next.

The President: You move that the discussion of this paper be left over until after the next?

Mr. Treherne: I second the motion. Carried.

A CAPSID ATTACKING APPLES.

(*Neurocolpus nubilus Say.*)

H. G. Crawford, Wilton Grove, Ont.

In the Province of Ontario four Capsids, or Plant-bugs have been found attacking apples, namely: *Neurocolpus nubilus, Lygidea mendax, Heterocordylus malinus* and *Paracalocoris colon.* The nymphs of the second and third are the so called "Red-bugs" described by Crosby of Cornell. *Lygus invitus,* the False Tarnished Plant-bug, occurs in abundance in the Province, but, strange to say, has not been observed doing any damage either to apples or pears, though a great pest in Nova Scotia and causing considerable damage to pears in New York State.

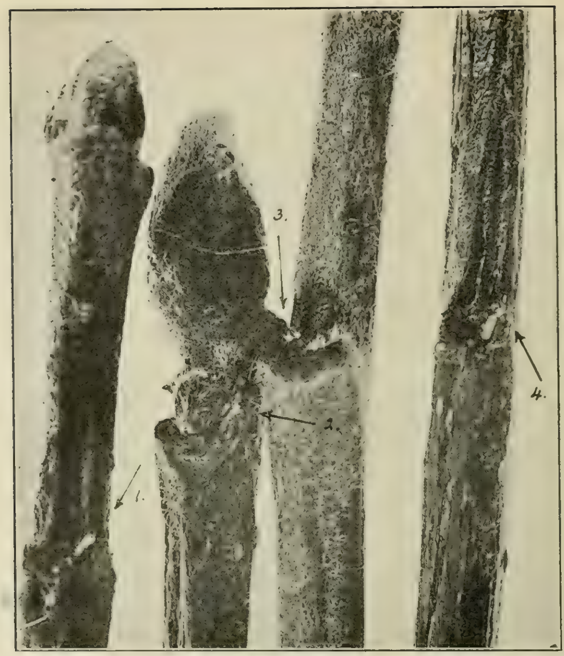
Of the above four injurious Ontario species the only ones of much importance so far as known at present are *Neurocolpus nubilus* and *Lygidea mendax.* Crosby in Bulletin 219 of Cornell University described the life history, habits and means of control of the latter; but very little was known about the former, and as this was the more common and troublesome Capsid in Ontario and, as requests for information on the means of control had begun to be made, Prof. Caesar decided to attempt to work out its life-history this year, being influenced also by the fact that this species was very common in the same orchard where he had planned to study the Leaf-rollers of the Apple. It was my good fortune to be chosen to do this work under Prof. Caesar's guidance and with his personal co-operation so far as his other duties permitted. The following is a brief account of the knowledge gained.

History of the Insect in the Province.

There is no doubt whatever that this Capsid has been present for many years in Ontario, in fact it is apparently a native species. It is only very recently, however, that it has been discovered to be an apple pest. In 1909 Prof. Caesar was shown by Mr. Jos. Tweddle some deformed apples that caused him to suspect that a Capsid might be to blame. In 1910 he accordingly visited Mr. Tweddle's orchard at Woodburn when the apples were about the size of small marbles, and saw the nymphs at work, though at the time he was not sure of the species. In 1911 he again visited the same orchard, saw both these nymphs and those of *Lygidea mendax* feeding on the fruit, and from specimens brought to Guelph reared adults of three species: *Neurocolpus nubilus, Lygidea mendax,* and *Paracalocoris colon.* In 1914 he found the former two species were in a large orchard at Hamilton, and in 1914 found nymphs of *Neurocolpus nubilus* alone in abundance in the orchard of Johnson Bros. at Simcoe. This is the orchard in which the investigation was carried out. There has been no opportunity to examine many orchards to see just how important the pest is in the Province. We suspect that it occurs in a good many orchards but know that the great majority of them are free or almost free from the pest.

Distribution.

This insect has a very wide American distribution. From literature at our disposal, records were obtained of its presence in a collection of Capsids made in Panama and Guatemala, in the States of Florida, New Mexico, California, Colorado, New Jersey, Maine and New York, as well as in the Provinces of Quebec



Eggs of *Neurocolpus nubilus in situ* on first-year Spy twigs, all, with the exception of (2) having had the leaves and buds removed. Enlarged about 5 times.

(1) Egg just as it was after the leaf and bud had been removed, half its length being buried in tissues of the twig;
(2) Egg, with leaf only removed, position at side of bud not normal, but curve of egg well shown;
(3) Two eggs close together, thrust very far down into tissue, and being completely hidden by bud and leaf;
(4) Eggs with tissue cut away from front, showing rounded lower end.

Adult *Neurocolpus nubilus*, and two nymphs.
(Natural size.)

and Ontario. In Ontario E. P. Van Duzee reported it as "common and highly colored" in Muskoka during July and August, 1888; he also saw a specimen that had been captured at Temagami in 1908. It has also been observed by Prof. Caesar, Mr. G. J. Spencer or the writer in the following additional places in Ontario: Woodburn, Hamilton, Fonthill, St. Catharines, Wilton Grove (Middlesex County), and in Norfolk County at Simcoe, Walsh and Tyrill.

Life History.

Eggs. Although we could never find a female ovipositing either in cages or in the orchard there seems no doubt that egg-laying extends over a long period, which this year would be from about July 15th to September 1st, most of it being over by August 15th, from which time the adults gradually decreased in number, completely disappearing by September 7th. The majority of the eggs are laid singly, but not infrequently two are found so very close together as to suggest that they might have been laid at the same time. They are invariably found behind

Adult *Neurocolpus nubilus* and nymph. (Enlarged.) Note the clavate hairs on antennae of nymph.

the buds which are situated in the axils of the leaves on the new growth. In addition to the Apple, eggs were found also on Sumachs. They were inserted into the tissues of the new growth. We suspect they are also laid in Elder though we are not sure. No eggs could be discovered on any kind of weed in the orchard. On apple trees they are so deeply pushed under the bud into the tissue that even the white tips are hidden from view. If the bud is removed the egg will be seen to be sticking out of the spongy tissue for from one-quarter in extreme cases to one-half its length, the average being about one-third of the length (see fig.). There is absolutely no external evidence of the presence of the egg when the bud and leaf are on the twig.

This year the eggs began to hatch on May 27th; the maximum hatching taking place between June 5th and June 9th. Freshly hatched nymphs, however, continued to be found up to July 13th.

In this connection it will be interesting to note the relationship existing between the maximum hatching of the various kinds of apple-attacking Capsids and the stages of the apple trees in each case. Thus this season at least (1915) the majority of the eggs of *N. nubilus* in Ontario hatched from *just after the*

calyces had closed up to the time when the fruit of the Spy trees was one-quarter inch in diameter. Lygidea mendax in Ontario and in New York hatches most freely *just as the blossoms are opening out well.* Of *Lygus invitus* in Nova Scotia the maximum hatching takes place *during the period of maximum bloom,* and of *Heterocordylus malinus* in Ontario during the period from the time the Spy blossoms are *opening up to full bloom.* Of *Paracalocoris colon* in Ontario the records are not definite, but nymphs gathered at Woodburn in 1912 with *N. nubilus* were in the same instar, suggesting that they may have hatched about the same time. However, in 1912 *N. nubilus* seemed to hatch somewhat earlier than in 1915; thus making impossible the assignment of a date of hatching for *Paracalocoris colon.* From this comparison it can be seen that a spray designed to control the other Capsids and which could be applied at the time of the spray for the Codling Moth would fail to control *N. nubilus,* at least during the season of 1915, because it would be too early for this species.

Nymphs. The nymphs, which appeared first on May 27th, at first grew rather slowly but later seemed to grow more rapidly. By June 11th the largest were about 3 mm. long, and by June 20th many were found 5 mm. long, exclusive of antennæ. About June 22nd the largest were slightly over one-quarter of an inch in length and wing pads were then present on quite a number. The first adult was seen on June 30th. Thus we suppose the nymph stage requires in the neighborhood of a month in a cold season like that of 1915. In a warm season, however, it is quite probable that less time would be required.

Adults. From June 30th the adults increased in number until by July 15th they outnumbered the nymphs present. Many of the females at this date were distinctly swollen with eggs, which upon being examined seemed to be perfectly formed and, though as mentioned above, no egg-laying was ever witnessed, there is no doubt that oviposition began about the middle of July. It is perhaps worth recording that we never saw any mating of the sexes. Males do not live so long as females. Several of the latter which were in the adult stage when put in a cage on July 9th were still alive on August 12th, having lived at least 33 days. From July 15th for two weeks the number of adults seemed to be constant, then began slowly to decrease till by August 24th very few were observed, and these had disappeared entirely by September 7th.

Description of Life Stages.

Eggs. The egg is 1.5 mm. long by .3 mm. in average diameter, quite strongly curved, slightly club-shaped, nearly colourless, with a glistening white cap. The end which is thrust into the twig is slightly larger than the other, is rounded, and circular in cross-section. Towards the other end the egg gradually flattens, is oval in section and is surmounted by a definite, glistening, white, cylindrical hollow cap, which makes up about one-sixth the total length of the egg (see fig.). The cap appears as though it had been slipped on over the end and is deeply notched on the flattened sides. The tips of the projections so formed, draw more or less together after the eggs are laid, suggesting somewhat a minute lobster claw.

Nymphs. The nymphs, when freshly hatched, are about 1.5 mm. long, almost colorless, with large triangular head, large dull red eyes and with long stout antennæ and legs marked with faint reddish bands. They are quite sluggish and were mistaken by one of Ontario's best apple growers for aphids.

All the later stages of the nymphs have green bodies with dull reddish mottlings upon the back and sides; the second abdominal segment has a small

circular black spot which persists in the adult though hidden by the wings. The antennæ are long and conspicuous, the first and second joints bearing a broad band of close-set, prominent, dark-brown, *clavate* hairs (see fig.). The legs are slender and distinctly marked with red bands. The nymphs, when in the last instar, attain a length of a quarter of an inch, and bear a pair of conspicuous wing pads. Nymphs in all stages after the first moult are very much alike, though the reddish mottling becomes more pronounced and darker as they grow older and increase in size.

ADULT. The adult is slightly more than a quarter of an inch in length being distinctly longer and narrower than the Tarnished Plant-bug (*Lygus pratensis*). (See fig.). The general colour varies greatly both in the case of those living on different hosts, where it is very marked, and also to a lesser extent among those living upon the same host. The dorsal aspect of those living upon the apple varies from a dull cinnamon brown with dark areas to a reddish black with light areas. It has a dull felty appearance due to the presence of numerous fine light to dark cinnamon hairs upon the thorax and thickened part of the wings. The sides are mottled with a dull, dirty red, and ventrally the colour is a light green. The antennæ are longer than those of the Tarnished Plant-bug. The basal joint is stout, dark in colour and densely clothed with dark brown hair, many of which in fresh specimens are distinctly clavate. The second segment is slender, elongate and slightly club-shaped, the distal half being dark brown and clothed with very short, dark brown hairs. The legs are slender and have the same reddish banding as those of the nymphs. Referring to this species Prof. E. P. Van Duzee states: "No other Capsid known to me has thickened, clubbed hairs on an incrassate first joint."

HABITS OF NYMPHS.

The nymphs, when they first appear, are rather sluggish in their movements and are found on the lower sides of the opened leaves, also in the unopened leaves, and in those leaves which had been rolled up by the Leaf-rollers. In these rolled leaves they remain at night and on cool or rainy days and in the cool part of the mornings, coming out and moving around somewhat during the heat of the day and feeding on the tender leaves. When the apples were about a quarter-inch in diameter these were attacked, the attack continuing for about ten days till the apples were a half-inch in diameter. Then the fruit was deserted and the great bulk of the insects made their way to the ground and soon were found feeding upon practically every plant growing in the orchard. The suckers at the base of the trees, red clover and curled dock were the favorite food plants. They fed also upon alsike clover, Canada blue grass, rye, evening primrose, peach trees, hairy vetch and timothy.

HABITS OF THE ADULTS.

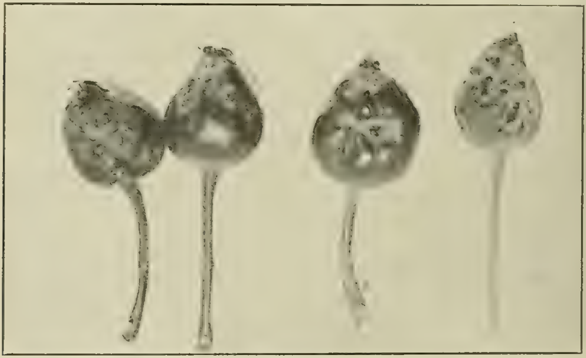
When the adults began to appear the great majority of them were found upon the weeds and suckers, where they remained for about a week. At the end of this time a small proportion of them appeared on the trees where they moved slowly about constantly feeding upon the buds in the axils of the leaves on new growth. The proportion of those on the trees to those on the weeds seemed to remain nearly constant throughout the season, there always being some on the trees but never very many. On and about July 19th an attack upon the aphid-stunted apples took place and even a few sound Spys one and three-quarters of an inch in diameter

were punctured, but this attack did not become at all general. However, at this time an attack of great severity was made upon the fruit of three trees of an unknown variety and lasted for a week. The adults feeding on the suckers, as before mentioned, confined their attention largely to the newly formed buds and the tender twigs, while those on the weeds showed a marked preference for the horseweed (*Erigeron canadensis*), which was abundant at this time. They seemed to be particularly fond of plants of this species infested by aphids. Other species of plants, however, were also fed upon, such as mullein, ragweed, pigweed, catnip, stinking mayweed, round-leaved mallow, burdock, golden rod, Hungarian millet, old witch grass, sumach, elder, orange milkweed (*Asclepias tuberosa*) and all the plants mentioned above as food plants of nymphs except where these had become too dry to attract them.

The adults, as a rule, were not very active and were quite easily captured, dropping from leaf to leaf when disturbed and only flying as a last resort.

INJURY.

FRUIT. The chief injury is due to the feeding of the nymphs upon the apples. It is done when the fruit is from one-quarter to one-half of an inch in diameter, and when the nymphs are still small. The first evidence of the attack is the



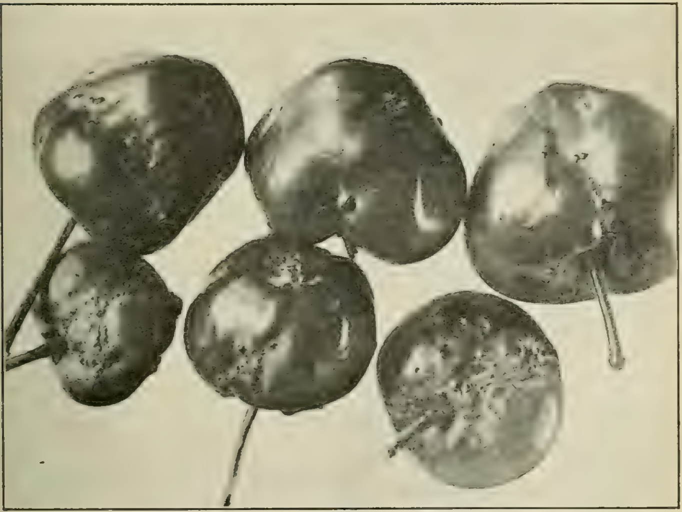
Injury due to the feeding of *Neurocolpus nubilus* nymphs upon young fruit very shortly after the attack. (Natural size.)

oozing of droplets of juice from the punctures which are made at any point upon the surface of the apple. These punctures in three or four days are evidenced by small, conical to rounded pimples, varying in height and diameter from 2 to 3 mm. In their apices are small, very dark green spots of tissue, beneath which is a very slight streak about 3 mm. deep. These pimples vary in number from one to twenty-five or twenty-six per fruit, and where abundant on a very small apple cause it to wither and fall; on a larger one they very severely stunt its growth, and if the pimples are massed on one side, they cause the growth on that side to be checked, and the apple to be much deformed when mature. Where the pimples are few or scattered the apple may grow to normal size and nearly normal shape, the pimples becoming gradually less distinct or forming small raised, brownish, corky areas or convex russet spots from 3-4 mm. in diameter.

The orchard in which the observations were made had almost no crop, so no proper estimate of the damage done by these insects was possible. One tree, however, which had quite a few apples, had about 40 per cent. attacked, but only about 10 per cent. rendered culls, the rest being quite saleable as second-class fruit.

About July 19th a few of the Spys were attacked by the adults, but the feeding was very slight and of no importance. At the same time a very severe attack indeed was made upon three trees of an unknown large, yellow, seedling variety. The attacked fruit soon rotted and fell, due possibly to inoculations of Twig Blight (*Bacillus amylovorus*) with which the trees were badly attacked, and to which they seemed particularly susceptible. It is probable that this Capsid was the chief factor in carrying this disease from limb to limb and from fruit to fruit.

Leaves and Twigs. No injury of any description was observed on the leaves



Injury due to the feeding of nymphs upon the apples when very small, about six weeks after the attack. Note the corky scars and pimples. (Natural size.)

themselves, but the tender buds in axils of the leaves of the young growth were punctured by both nymphs and adults, many of them being killed. The young twig itself was also punctured and, when badly attacked, the puncturing was followed by a small, very convex gall, which later in many cases split and became corky upon the top (see fig.). Both of these kinds of injury were confined largely to the suckers which became bushy and stunted with the tips of the twigs frequently dying. The new growth on the trees themselves was very seldom more than slightly injured.

Summary of Control Experiments.

In our control experiments kerosene emulsion and carbolic emulsion were both found to be almost useless for, even when applied with great thoroughness they failed to kill more than a small percentage of the nymphs.

Black-Leaf-40 was used alone with water in the proportions of one part of the solution to 1,066, 800, 400 and 250 parts of water respectively, but in no case was it at all satisfactory as it only killed a small proportion of the nymphs, even of the small ones. At first we thought that this spray would kill at 1 to 800 both by contact and by the fumes, but experiments showed that the nymphs were not dead but only stupefied and that they soon revived and appeared to be none the worse for the treatment.

Severe case of injury due to feeding of both adults and nymphs of *Neurocolpus nubilus* upon suckers at the base of the apple trees. (Natural size.)

The Black-Leaf-40, however, when used with soap—1 part of the solution to 800 parts of water, with 4 lbs. *Sunlight Soap* per 100 gals. of mixture—produced a spray which killed 96 per cent. of nymphs of all sizes, most of them being large. The tree was, of course, thoroughly covered with the mixture. Soap alone gave almost as good results but, owing to scarcity of nymphs at the time it was tried, was not given so many or quite so good tests. The results, however, were very gratifying. The efficiency of the soap spray was seen to depend chiefly upon its

stickiness and power to glue the nymphs to the leaves and twigs. For this purpose Sunlight Soap was found the most satisfactory of any soap tested.

It should be mentioned that owing to the large number of rolled leaves due to the work of the three species of Leaf-rollers that were very abundant in this orchard, it was found impossible to get good results from spraying large apple trees because there was always a large proportion of the Capsid nymphs hidden in these rolled leaves where no spray could reach them. Consequently all experiments were performed on trees 4 to 5 years of age. Any rolled leaves on these were first removed, then large numbers of nymphs were placed on the trees and given plenty of time to settle down before the spraying was done.

We found also that the time of hatching of the eggs of this Capsid compared with those of the Red-bugs and of the False Tarnished Plant-bug was as mentioned above, so much later that the spraying just after the blossoms fell, recommended for them, would be useless for this pest, because only a very few eggs would be hatched at this date.

Suggestions for Control.

1. Practise a system of clean cultivation of the orchard, keeping down all weeds until the end of June or as late as safe for the trees in that district. This will destroy large numbers of the nymphs which drop to the ground and which, unlike some species of Capsids, have no instinct to lead them back to the trunk and so must perish if there are no weeds to feed upon.

2. Watch the trees closely from the time the blossoms fall to see when the nymphs hatch and are abundant enough to justify spraying. Then apply with great thoroughness both to the upper and lower side of the foliage either (*a*) 2 lbs. of Sunlight Soap to 40 gals. of water containing Black-Leaf-40 at the strength of 1 part to 800 of water, or (*b*) 3 to 4 lbs. of Sunlight Soap to 40 gals, of water, preferably rain water if available. Dissolve the soap first by slicing and boiling in soft water.

In exceptional cases it may be necessary to repeat the spraying in a couple of weeks.

It is of course well to test the mixture on a few trees and observe results before spraying the whole orchard.

The President: These two papers should provide a very interesting discussion as I know there are a number of workers here who are particularly interested in the injuries caused by these insects.

Prof. Brittain: In regard to Mr. Crawford's statement that he was able to destroy 96 per cent. of the insects with Black-Leaf-40 and soap, I may say that our results were about the same. Unfortunately, the insects were so numerous that the remaining 4 per cent. left many thousands to infest the trees and ruin the crop.

Mr. Treherne: The subject of Capsids affecting apples is a very important question in British Columbia. Blossoms in orchards, miles in extent, have been destroyed by Capsids and I am interested in the two papers that have been read.

Prof. Caesar: Do you remember by what species?

Mr. Treherne: As far as I know it was *L. pratensis,* but we have not given the matter much attention as yet.

Prof. Brittain: I am well acquainted with the injury referred to by Mr. Treherne. During my stay in British Columbia a good deal of this Capsid injury came under my notice and considerable material was sent in to the office. I looked

into the matter and succeeded in finding the insect responsible, but was not able to get it determined. If my memory serves me rightly, it was neither *pratensis* nor *invitus*. One of its favorable food plants is the mullein.

PROF. CAESAR: There are a number of interesting points of comparison between *Lygus invitus* and *Neurocolpus nubilus;* (1) The damage done by the latter is not nearly so great as that done by the former as described by Prof. Brittain, and there is none of that corky growth or rough brown surface mentioned by him. (2) *Neurocolpus nubilus* seems, unlike the other species, to have no instinct to cause it, if it drops to the ground, to find its way back to the trunk, but instead wanders aimlessly around. *Neurocolpus nubilus* will feed on a great number of plants. It is probable its native host plant is sumac.

It is strange that while *Lygus invitus* is to be found all over Ontario in just as great abundance apparently as the other species, it does not, so far as I can see, do any harm to apples or pears. As for the difficulty of seeing the insects laying eggs, both species must be much alike for we could never find *Neurocolpus nubilus* ovipositing or even copulating.

MR. PETCH: This year we had a frost in the blossoming period, and I think the injury was caused by frost to the blossoms. However, as the injury occurred on only one tree I cannot see how that can be the cause, and I do not know what the injury to blossoms by this insect is like. Does it give the appearance of having been frozen?

PROF. BRITTAIN: Yes, it looks very much like fire blight. The blossoms are brown and dead and I attribute a great deal of the so-called frost trouble to *Lygus invitus*.

MR. PETCH: With the use of Black-Leaf-40 in the ordinary strength do you find it injurious to the foliage of apples?

PROF. CAESAR: We found that where Black-Leaf-40 was put on very heavy along with lime surphur it did seem to injure the apple foliage to some extent.

MR. TOTHILL: The two accounts we have had of *Lygus invitus* in Ontario and Nova Scotia suggest the possibility that there may be two species concerned. The species of American Capsidæ are, of course, based on a study of museum specimens only. They are not based on habits and as the group is an extremely difficult one to do anything with, and as no breeding work of any kind has been done, it seems to me from the great differences in the habits of the so-called species that it is just possible there are two species concerned.

PROF. BRITTAIN: Mr. H. H. Knight writes me that he is convinced that the species in Nova Scotia is a new variety. He intended to describe it as such in the near future.

MR. TOTHILL: That would seem to bear out this contention.

THE PRESIDENT: If there is no further discussion on these two papers we will proceed to the next, which is a paper by Dr. Cosens entitled, "The Founding of the Science of Cecidology."

THE FOUNDING OF THE SCIENCE OF CECIDOLOGY.

A. COSENS, TORONTO.

At a time when the problem of gall formation is exciting deep and increasing interest, it seems opportune to consider for a few minutes those investigators, who, lured by the fascination of the subject, laid the foundation for its scientific treatment.

Centuries before any serious attempts had been made either to describe the structure of galls or to explain their origin, these abnormal vegetable growths had been noted and commented upon. The early ideas concerning them were fanciful in the extreme; such terms as "thunder bushes," and "witches' brooms," still popularly used, have crystallized in them the superstitions that enshrouded the origin of these structures. Some of the primitive, whimsical notions concerning them have been adhered to with surprising persistency. Even as late as the 18th century, Reaumur states that a number of German savants still attributed the production of *Neuroterus baccarum* Linn. to Satanic agencies. At the far-off time when galls first began to have a prominent place in the ancient botanical writings, ignorance frequently ascribed supernatural attributes to anything at all unwonted, or even occasional, and events of outstanding importance were often supposed to have been portended by perfectly natural trivial occurrences. It is not surprising, then, that the earliest naturalists should have seen, in the unusual structure of galls, signs that forboded the future. If an uninjured gall, opened in January or February, contained a fly, war must inevitably occur; if a worm, famine was foreshadowed; while a spider betokened pestilence. "Always for ill, and never for good," were the auspices. That the data, presented by galls, could be interpreted as a representation of the future, was proposed first by Magnus, in the 13th century, but the omen was still accepted by Lonicer and Mattioli, in the 17th.

When the old writers first refer to galls, they are sufficiently well-known to constitute an important part of the list of prescriptions formulated by the physicians of that age. A solution of the gall substance in water, or wine, was the common form in which these remedies were applied. Their marked astringent properties were familiar to the ancients, and, in this connection, it is interesting to note that gall products are still found in the British pharmacopoeia as astringent ointments. Two eminent writers, before the Christian era, who have made somewhat detailed reference to galls, are Hippokrates (406 B.C.-377 B.C.) and Theophrastus (371 B.C.-286 B.C.). The former, a famous Greek physician, dealt with the subject almost exclusively from a medical viewpoint. At various places in his writings he makes detailed reference to the efficacy of galls as remedies in cases where an astringent action is desirable. The latter's work indicates more of the qualities of the naturalist in its author, who must have observed the specimens rather closely, as, in general, he refers to their many sizes and colors, and to the various shapes of particular forms. He especially mentions a gall covered with weak hairs, that would serve as a wick, and a particularly hairy specimen that exuded a honey-like juice. One of the most striking observations which he has recorded is that the elm galls of *Tetraneura ulmi* were suitable for caprification, since they contained animals. Although it is apparent that he must have observed the insect producers, he did not, however, appreciate the relation between their presence and the origin of the gall. Also, the galls on the ash and pistachia were familiar to him, and with them he compares those on the elm. Theophrastus may have been taught the importance of observational work by Aristotle, whose favorite pupil he was.

While the work on galls of Pliny the Elder, who died in the eruption of Vesuvius, A.D. 79, is better known than that of any other writer of antiquity, yet he contributed very little really new material to the knowledge of the subject. He treats chiefly of the oak gall of commerce, *Cynips tinctoria* L., produced on *Quercus infectoria*. He distinguishes several forms of it, and names the variety of oak upon which each is found. He mentions in this classification the green gall-nut on the "hemeris" oak as the one best adapted for the preparation of leather,

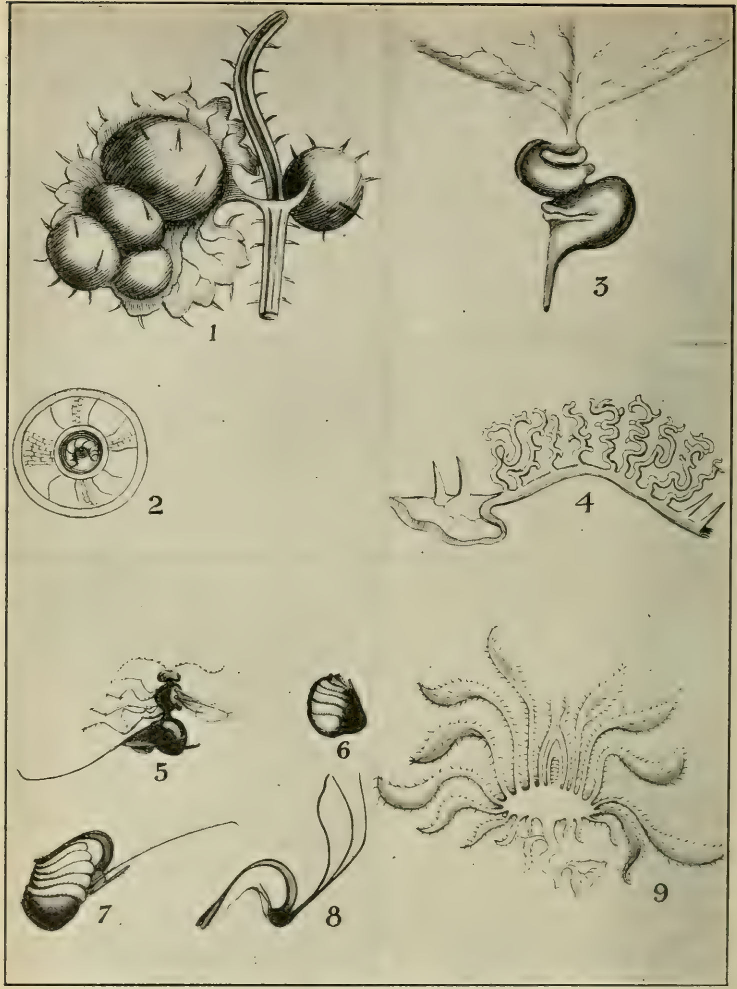


PLATE IV.—REPRODUCED FROM MALPIGHI'S "DE GALLIS."

Fig. 1.—Gall produced by *Aylax glechomae* Linné, on ground ivy. Fig. 2.—Section showing the larval chamber and the enclosed larva.

Fig. 3.—Aphid gall on the leaf of poplar.

Fig. 4.—Mite gall; the producer was unknown to Malpighi.

Fig. 5.—Cynipid producer; 6.—Abdomen of producer, with ovipositor retracted; 7.—The same with ovipositor protruded; 8.—Ovipositor.

Fig. 9.—Section of a willow gall, produced by a midge.

and the white gall-nut parasitic on "latifolia" as similar to the preceding, but lighter in color, and slightly inferior in quality. He includes, as well, the black gall-nut that grows on both the "latifolia" and the "robur" varieties of oaks. He states that the black gall-nut, when on the latter host, has holes in it, and is, in consequence, of much less value. The holes, that he notices apparently only in this form, were without doubt the exit channels of the producers. But, unfortunately for the progress of the science, this point escaped him entirely, and he saw in them nothing but a proof of the inferior character of the galls.

In common with his predecessors, Pliny shows the most perfect confidence, real or assumed, in the value of the medicinal properties of gall extracts. He recommends their use in the treatment of twenty-three different ailments, ulceration of the mouth, affections of the gums and uvula, burns, etc. Toothache may be allayed by merely chewing a little of the gall, but, to secure the best results in more serious disorders, the gall substance should be burned and quenched in wine, or in a mixture of water and vinegar. Pliny no doubt owed much that he has stated concerning the healing properties of galls to his contemporary, Dioscorides. This author named and described five or six hundred plants supposed to be medicinal, and included oak-galls in this primitive materia medica.

In addition to the oak-gall of commerce, the writings of Pliny contain references to other galls. He states that the "robur" oak produces one that can be used for illuminating purposes, and another that contains a sweet juice. These are clearly the same species mentioned by Theophrastus. In the axils of the branches of this same oak, Pliny has observed galls. Following his description of the species, it adheres to the bark without the medium of a stalk; at the point of junction with the host the gall is white, but is spotted elsewhere with black; the inner substance is scarlet in color, and has a bitter taste. Quite a concise and detailed description, considering the early developmental stage of the subject. It has been inferred that Pliny had seen Cynipid producers, since he speaks of a sort of gnat in watery pustules on the leaves of the "robur" oak. Clearly the correlation between the life-history of the insect and that of the gall was not noticed by him, and indeed it is not perfectly conclusive that he recognized the nature of the oak pustule as the same as that of the gall-nut, although he states that the two species mature in about the same way.

Many of the statements of Pliny incline us to the belief that he was influenced to a greater degree by tradition than by observation. Only some such charitable conclusion can explain his assumption that gall-nuts are a fruit of the oak, produced in alternate years with the acorns; or that the gall-nut develops in a single day, but shrivels up immediately if the heat strikes it.

The writers already considered may be regarded as representative of the ancient period of the literature dealing with galls. That era, in reality, contributed very little to our knowledge of the subject. Swellings on certain plants had been noted, and, in some instances, described, but, apart from that, nothing of scientific value had been accomplished. At that time, different hosts, such as the oak, beech, rose, and ash, were known to bear galls. They were supposed to be a fruit-like product of these trees, and it is extremely doubtful that the deformities on the various hosts were known to be of the same fundamental character. It is almost impossible that they could be so regarded, since the common and unifying element, their production by an insect, was unknown. The consideration of galls as fruits caused them to be looked upon as natural products, and made any attempt to explain their origin quite superfluous. During this period, confidence in the medical properties reached its maximum, and their extracts were recommended as infallible remedies for a long list of diseases.

For 1,600 years after the time of Pliny the scientific world slept, and, as a consequence, at the beginning of the 17th century the work on galls had been advanced very little beyond where the ancient naturalists had left it. During the time elapsed, while no appreciable progress was made, several writers had incidentally mentioned galls. Magnus (1193-1280), and Konrad von Megenberg (1309-1337), in particular, have referred to them in their general discussion of the oaks. The latter author introduced the term "oak-apple" as a synonym for the older name "gall-nut." Mattioli and Lonicer, about the year 1600, wrote on the subject, and, in imitation of the early physicians, recommended the gall extracts as a panacea for many ailments. Galls, acorns, and mistletoe were regarded as three varieties of oak fruit by these authors. Their belief in the oracular powers of galls has already been considered.

These desultory references to galls, however, do not indicate any special interest, and we may say that the subject had never been approached in a serious scientific manner until its importance attracted the attention of the Italian physiologist, Marcello Malpighi (1628-1694). This investigator was the outstanding figure of his age in medical science. He was physician to Innocent XII, and professor of medicine at Bologna, and afterwards at Messina. In his methods, he isolated himself entirely from the dogma of tradition, and based his conclusions upon his own observations. In his research work, he investigated the anatomy of the brain and lungs, and made a beginning in embryology by tracing the various stages in the development of the germ in the hen's egg. While his work along zoological lines has placed him in the front rank of the scientists of his own era, that on the botanical side has marked him out as one of the leading naturalists of all times. When a biologist of such ability penetrates into a practically unexplored region as that presented by the subject of galls, it is to be expected that the progress made will be quite phenomenal, and this has proven to be the case. The science of cecidology, with the founding of which Malpighi must be credited, was based by him upon taxonomic knowledge. His catalogue, "De Gallis," published in 1686, contains descriptions of a large number of Italian and Sicilian galls, and shows the intimate familiarity of the author with the included types. Prior to this work, the galls that appeared in the literature were, with few exceptions, confined to the rose, beech, and oak. But, in addition to such well-known forms as *Rhodites rosæ, Andricus fecundatrix, Cynips Kollari, etc.,* he has described others that are less common and more restricted in their distribution. For example, he collected *Aylax glechomæ* Linn. parasitic on *Nepeta hederacea*, a gall that has been widely introduced into America, and is almost certain to be found wherever the Ground Ivy is established. He was also the first to observe the beneficial gall nodules on the roots of Leguminous plants, and had noticed, as well, Erineum galls without being familiar with their production by mites. The deformities of this nature he has mentioned are those produced on Vitis and Populus. Malpighi did not concern himself only with the characteristics of the external form of galls, but applied his knowledge of plant anatomy to the investigation of their internal structure. By this means he became familiar with the course of development of several galls, and the typical stages of individual species.

Valuable as was the contribution thus made by Malpighi to our botanical knowledge of galls, it was overshadowed by the importance of his work along entomological lines. Indeed, the complexity and importance of the problem presented by the production of galls was never fully appreciated until he discovered their insect origin. Only then was the question seen clearly in its dual character, involving a stimulation by the producer, and a reaction by the host.

That he understood the nature of this reaction may be deduced from his statement that the plant is compelled to furnish a deformity that serves to nourish the deposited eggs of the insect. He must have observed the producers very closely, as he gives a detailed account of the curious ovipositor of the Cynipidæ, and mentions, also, the stalked character of their eggs. He further discovered that the galls are not left to the undisputed possession of the producers, but are inhabited by other insects. He seems to have grasped fully the importance, not only of a close study of the host plant, but also of the habits and structure of the insect parasite.

Malpighi has recorded a number of reflections concerning the biological relation between plant and insect in gall formation. His theory summarized in brief is that a poison, introduced at the time of oviposition, breaks down the substances of the cell sap, and diverts the currents of its transference into wrong channels, thus producing malformation by causing the growth energies of the plant to be wrongly directed.

Particularly interesting to us, as students of insect life, is the fact that the founder of the science of cecidology, realized the importance of the entomological viewpoint of the subject.

The President: As the writer of this paper is not present and as its historical nature rather frees it from any discussion, we will proceed to the next paper by Mr. Strickland on "The Army Cutworm in Southern Alberta."

THE ARMY CUTWORM IN SOUTHERN ALBERTA.

E. H. Strickland, Entomological Branch, Department of Agriculture, Ottawa.

The Army Cutworm (*Euxoa auxiliaris*) is new to Canada as a field pest, though it is a native species of the Western Provinces. Fletcher recorded it in 1903 as injurious to gardens in Regina and Calgary, but apart from this report the insect has not been described as one of any economic importance in Canada. Since 1898 it has been a frequently recurring field pest in Montana, where it was given its popular name.

In 1915 an extensive outbreak of this insect occurred in Alberta, and covered a territory of about 3,000 square miles. The resulting study of the insect from an economic standpoint brought to light several interesting features in its life-history and habits.

The eggs are laid in September and October, mainly upon weedy fields. We were unable to find eggs in the field, but in all the experiments in which we reproduced natural conditions in so far as we were able the eggs were laid in the soil—near, but never actually upon, vegetation. This suggests, therefore, that even though the eggs of this species may be found on vegetation the majority of them are laid in the soil. We believe that this will be found to be true of several other cutworms which are described as laying their eggs exclusively on vegetation.

The eggs hatch in the autumn, and the young larvæ hibernate in the soil. Soon after the frost is out of the ground in the spring they come to the surface and feed upon the weeds. When the cutworms are numerous they soon destroy all of the weeds upon the fields where they hatched and have passed the winter. Then, like the Army-worm, they move off more or less in a body in search of more food.

Their general trend of migration, in all cases observed, has been towards the north-west. We believe that they are oriented by light. As in the adult stage these cutworms display a positive phototropism to artificial light, and also to subdued daylight, such as is experienced soon after sunset. Also, like the adults, they avoid strong daylight. The latter tendency causes them to remain below ground on bright, sunny days. It happens, however, that when the cutworms are sufficiently numerous to assume the migratory habit, they have been unable to obtain enough food to appease their hunger. Hunger causes them to migrate, and it may become so intense that it overcomes their aversion to exposing themselves to direct sunlight, so that they come above ground by day, and crawl rapidly in search of food. This search is haphazard. They are not making for any definite feeding ground, of which they have some knowledge. They crawl, therefore, in the line of least resistance—that is, away from the sun, or in a more or less northerly direction. We have disturbed adults hiding under clods at noon time, and they too, in nearly every case, flew more or less due north. In the evening, when the sun is low, its weakened light seems to attract, as does that of an artificial light, and the cutworms crawl towards it. It is at this time of the day that migration usually begins. Once more this agrees with the adult habits; for the moths begin to fly at dusk, and an examination, soon after sunset, of the windows of a barn shows that most of the moths of this species are congregated on the western windows.

The food plants include practically all weeds, field, and garden crops. Larvæ even ascended young Manitoba maples and ate the bark off the twigs, thus killing the trees. They are entirely superficial feeders, and never cut off plants below ground as do the common cutworms.

The pupæ are found in the usual earthern cells made by the Agrotine species.

The moths fly from the middle of June till the end of September or early October. They may æstivate during the hottest part of the summer, and so appear to be double brooded. There is, however, one brood only. During the first flight the ova remain undeveloped, but the moths feed freely and accumulate fat body. After the period of æstivation the eggs have begun to develop, and they are laid during the autumn.

The moths are a serious domestic pest, and gain access to well screened houses. Contrary to general belief, very few of them are attracted into houses by the lights. A lighted lamp merely attracts around it the moths already in the house. The majority of moths enter houses between the shingles or through cracks around doors and windows. They enter these crevices in the early morning for protection from the daylight, working so far in that many of them are unable to find their way out again. Many of these crevices communicate, by however devious a course, with the interior of the building and the result is that a number of the moths gain admission to houses from which the smaller house flies, which avoid dark chinks and crannies, are effectively excluded. The moths are attracted only from a short distance by light, and in this connection it may be mentioned that light traps in the fields proved to be an absolute failure. The majority of moths migrate to buildings soon after they emerge, and remain there until they are mature.

The destruction of the larvæ by poison can be accomplished with comparative ease. This is done most economically by the use of a poisoned bait applied to specially prepared furrows. In wet seasons a vertically sided furrow can be used but under the conditions prevailing in southern Alberta the soil is usually too dry for its construction without expensive hand labor. Under such circumstances it can be replaced by a dusty sided furrow, made by drawing a heavy log through a

deep plough furrow. For bait we used either sweetened shorts, which proved to be far superior to bran, or some green vegetation, such as Stinkweed (*Thlaspi arvense*), or alfalfa, poisoned with Paris green. The cannibalistic tendency of these larvæ proved to be of great benefit, since the poisoned larvæ, which soon lined the treated furrow, were eaten readily by subsequent arrivals, and definite experiments proved that under these circumstances they themselves furnished a very effective poisoned bait.

The cutworms appear early in the season, before the spring grain is sown. If they are observed in large numbers in a field which is being prepared for seeding, extra care is taken to remove all traces of green growth, a poisoned furrow is prepared right round the field, and seeding is proceeded with as usual. The lack of food results in a rapid migration of the larvæ already on the field, and by the end of the week necessary for the germination and appearance of the crop, the majority of them will have entered a furrow and have been poisoned, while others attempting to enter the field from the outside also will be trapped. Sometimes it is advisable to make more than one furrow along the menaced side of the field, and if the season is so advanced that germination is rapid, it may be necessary to plough subsidiary furrows at intervals through large fields.

Fortunately, we have no evidence which would lead us to anticipate a frequent recurrence of the pest, and we feel that similar outbreaks to that experienced this year can be held in check by the control measures advocated above.

THE PRESIDENT: I think all will agree as to the very practical nature of Mr. Strickland's paper and at the same time its value on account of the very interesting points he brings up regarding certain biological questions. Mr. Strickland certainly won two victories in the West this past season. He won a victory over the Cutworms, and he won a more important one than that, the obstinacy of the farmer, who is always very chary about adopting any remedial measures from experts unless you can convince him by demonstration. The way he was able to break through that obstinacy on the part of those farmers who were not willing to accept advice unless they were shown is really one of the valuable lessons we learn from the method we now have of carrying out our work through the field stations. Secondly, the fact that Mr. Strickland had to begin the study right from the very beginning, and leave behind him all the previous historical matter regarding the treatment of Cutworms under other conditions and in other parts of Canada, shows what a difficult task he had. There are a number of points in his paper which might be the subject of a very interesting discussion; for example, the behaviour of the larva as compared with the behaviour of the moth. They behave practically the same both towards artificial light and towards the natural light of the sun. Apart from its practical interest, of course, this paper does bring forward very emphatically the necessity of studying the behaviour of insects, and I believe that in our practical work we are coming more and more to realize that we shall have to go in for behaviour studies in addition to the study upon which so much of our advice has been based in the past, that is, studies of the life-history. We have many instances of that, such as the recent work in regard to the Fruit Flies of various species and work in connection with the relation of the ants to the Corn Root Aphis, all of which tends to prove that life-history study only leads so far in many instances. That is one of the most important things that Mr. Strickland's paper brings out. The paper is now open for discussion, and I have no doubt that a number of the members would like to take up certain matters.

PROF. LOCHHEAD: Did Mr. Strickland say what effect the juice of lemon has upon the mixture as an attractant?

Mr. Strickland: We tried using the juice of both oranges and lemons when poisoning in the trench, but found that since the bait was not in competition with a growing crop there was no necessity to use it; and as a general rule we found that the fruit juices made very little difference. We have been using a series of cages sunk into the ground over a growing crop, 9 feet square, so that we can put in each a certain number of cutworms, apply poisoned baits, and tell exactly what our poisons are doing. We did some forty or fifty experiments in them this year with various poisoned baits, and generally about three days afterwards we would recover all of the larvæ, living or dead, from the soil, and in that way we were able to tell the relative values of the baits used. Here also we find that fruit juice has very little beneficial effect, and that cane molasses is very much inferior to beet molasses.

Mr. Winn: I would like to ask Mr. Strickland about the first stage of the insect, namely, the egg-stage. When the eggs were found were they attached in any way?

Mr. Strickland: We never found more than three together.

Mr. Winn: Did you notice where they were laid?

Mr. Strickland: Of course we disturbed them when we examined them, but we found that particles of earth were attached all around them, and therefore we concluded that they were laid in the soil rather than on the soil.

Mr. Winn: I have examined several of the eggs and it was very peculiar the way they were laid.

Mr. Strickland: Our examination of vegetable matter has been naturally far more thorough than that of the soil, and we have never found them on vegetation, so that we are rather forced to the conclusion that they are laid in the soil.

The President: Perhaps Mr. Gibson would have some remarks to make on this subject.

Mr. Gibson: I am afraid I can add very little to what Mr. Strickland has already said. He seems to be working under conditions peculiar to Southern Alberta. In the East, here, we frequently find the eggs of Cutworm moths laid on leaves, and even on the stems of trees, but we have not ourselves, as Mr. Strickland has, located any eggs in the soil in eastern Canada. In the case of the Variegated Cutworm, which was so abundant in British Columbia in 1900, the eggs were laid on the leaves and stems of trees, windows, verandahs, and even on clothes hanging out to dry. In regard to the control of cutworms in the East, we this year used the locust poisoned bran formula with good results. Twenty pounds of this, if spread properly, is sufficient for two or three acres.

Mr. Criddle: I would like to say that I have also been carrying on a few investigations in Cutworms during the past season, and I found that market gardeners near Winnipeg had very little faith in oranges or lemons. They had remarkable success by using both bran and shorts (the majority were in favour of shorts) and just molasses in addition, and my results seemed to bear out what they said.

Mr. Tothill: I would like to ask Mr. Strickland if in connection with the Noctuids there is any special machinery in connection with any of the ovipositors for laying eggs beneath the soil?

Mr. Strickland: Whenever we disturbed moths in the day time they were always beneath clods and so beneath the soil.

Mr. Wilson: I would like to ask Mr. Strickland about what time the Cutworms appeared in Alberta this summer?

Mr. Strickland: They appeared as soon as the frost was out of the ground, the very first record being of larvæ attracted to light at the Provincial Jail on April

7th, and on about April 10th we had an account from the country where we found them plentifully.

Mr. Wilson: In 1900, about the 15th June, I received a report of damage by potato beetles up North and I proceeded there, but could find no potato beetles of any kind, and I had good evidence that cutworms were present.

The President: If there is no further discussion on this paper we shall now bring this session to a conclusion.

Mr. Gibson: Several of the members undoubtedly would like to spend some time looking over our collections here, and as I think we have plenty of time for all the papers on the programme to-morrow morning, I would move that the session begin at 9.30 instead of 9.00 o'clock.

Mr. Tothill: I second that motion.

The President: To-night we are to have the privilege of hearing a public lecture from Dr. H. T. Fernald, State Entomologist of Massachusetts. Dr. Fernald has been most kind in stepping into a breach which was made by the unfortunate accident to Dr. Howard, who would otherwise have delivered this lecture, and I take it for granted that everybody here will be there to-night as we ought to give Dr. Fernald a good audience, and I hope the members here will do their best in bringing their friends to hear Dr. Fernald. The lecture starts at 8.00 p.m.

The meeting is now adjourned.

Thursday, Nov. 4th.

EVENING SESSION.

LIFE ZONES IN ENTOMOLOGY AND THEIR RELATION TO CROPS.

H. T. Fernald, Amherst, Mass.

From the time when the late Alfred Russel Wallace published his epoch-making volumes on "The Geographical Distribution of Animals," this subject has been one of extreme interest. Wallace used his discoveries in this line as evidences of evolution, and provided many able arguments to support the theory from that source. The possibility of a practical application of distribution to agriculture, however, seems not to have received consideration by him, and it was apparently left for Dr. C. Hart Merriam to present this phase of the subject, though in a somewhat general way, in his paper on "Life Zones and Crop Zones in the United States," about a quarter of a century later.

Two years ago, Dr. E. M. Walker, in his presidential address before this society, discussed at some length the life zones as they are found in northern North America, and therefore only a brief reference to this phase of the subject is necessary at this time. Studies of the distribution of plants and animals all show that on any continental area, belts running from east to west across the country are inhabited largely by the same forms, while as we go north or south to the limits of these belts, we find other species beginning to present themselves, and these increase until finally we are surrounded by a fauna and flora almost entirely different, and belonging to a different belt.

Such belts constitute the so-called life zones and these are grouped into regions, that covering the tropical portion of the continent being called the Tropical Region,

that next the north the Austral Region, and the northernmost, the Boreal Region. Naturally we are interested mainly in the last two of these areas.

Canada is, of course, largely within the Boreal Region, but the differences within her territory are such that three sub-belts, called zones, are easily recognizable. On the north, beyond the limit of the growth of trees, we find corresponding changes in plant and animal life, establishing the Arctic Zone of the region. Here are typically Arctic plants and such animals as the Arctic fox, polar bear, musk ox, and ptarmigan. South of this, stretching across the continent from Labrador to Alaska, and southward along the tops of the Rocky Mountains is the so-called Hudsonian Zone. Its southern limit extends from near the mouth of the St. Lawrence River to the southern end of Hudson Bay, thence passes northwest to near Great Slave Lake, then down the Mackenzie River to about 65 deg. latitude, after which, influenced by the mountainous heights, it extends again to the south to about latitude 55 deg., sending narrow tongues farther south along the mountain tops. As it approaches the western ocean, however, the moderation of climate due to the Kuro sivo, or Japanese Gulf Stream, makes its influence felt, and the southern edge of the zone is driven north and is only able to reach the western shore of the continent about five degrees farther north than it was when the effects of the ocean came within reach. As neither the Arctic nor Hudsonian zones of the Boreal Region has great agricultural value, we now turn to the third zone of this region—the Canadian—which with certain exceptions occupies the rest of the Dominion of Canada and a portion of the United States. Here we must look for the greatest agricultural returns and one of the best opportunities for the utilization of crops not as yet grown.

The Austral Region occupies but a small portion of Canadian territory, but what it does occupy is of great value, for here it should be possible to produce crops not raised elsewhere in the Dominion, and to produce to perfection crops only partially successful in the Canadian Zone. Like the Boreal, the Austral Region is divided into three zones, the northern one being known as the Transition Zone. How accurate our knowledge of the area occupied by this zone as shown on the map is, may be questioned, but a strip around the Bay of Fundy and along the shore of Lake Ontario, and the Southern parts of Manitoba, Saskatchewan, and Alberta, besides the shore belt in the region of Vancouver Island, are believed to belong to this section.

Next south comes the Upper Austral, and this appears to be present in Canada only as a narrow strip along the shore of Lake Erie. How correct this is must be determined by future investigation.

It is a safe statement that Life Regions and Zones are always limited by barriers, though these may be of many kinds. Every kind of animal and plant has an optimum temperature at which it thrives best. As we depart from localities where this is true, and pass to the north, we will reach a latitude where it can no longer exist, while if we pass to the south the same will hold. Sometimes the limits will be established, not by temperature but by absence of food or by a change from a moist to an arid climate or the reverse. A mountain chain of considerable height may so affect temperature that forms reaching it are unable to cross and enter a continuation of the same zone beyond. Near the shores of our continent the influence of the ocean is a modifying factor, and others might also be enumerated, all affecting the arrangement of the regions.

Evidence indicating the limits of these zones is gathered by a study of the plants and animals present. Many plants found only a short distance south of the international boundary disappear as we pass northward, and with them disappear

animals feeding on those plants, unless satisfactory substitutes can be found. The cold of winter holds many forms in close agreement for their northern limit with certain isothermal lines, and by a study of these and other factors, a general understanding of the zonal areas can be obtained.

At the present time investigations on this subject are mainly by preparing faunal and floral lists for different localities, particularly from places presumed to be near the borders of the zones, and as a whole the latest results seem to indicate that the Upper Austral Zone extends farther north than was formerly supposed to be the case. It is, of course, recognized that no absolute line separates the zones, but that they overlap somewhat along their edges, leaving more or less of a "debatable ground," but despite this, approximate limits have a significance when it comes to the selection of the most successful crops to raise in any locality, and even local modifications are worthy of consideration.

The speaker regrets a lack of knowledge of local conditions of Canada as bearing on this point. Certain examples from cases with which he is familiar, however, may be suggestive and be possible of application here.

The State of Massachusetts is mountainous at its western end, numerous peaks reaching a height of more than 2,500 feet, and that whole portion of the state is more than a thousand feet high. East of this the state is crossed by the broad Connecticut River Valley, where, except for a few hills, the elevation is everywhere less than 500 feet. The central part of the state is higher again, the general elevation of the land except for narrow grooves cut by streams, being over a thousand feet. The eastern third of the state, however, is all less than 500 feet above sea level.

So far as elevation goes, therefore, the eastern part of the state and the Connecticut Valley should have much in common. Such differences in elevation in the state as have been indicated should not be of such importance as to affect apple raising, for instance, but they do result in the appearance of minor differences which all have their effect.

But even two such similar areas as the eastern end of the state and the Connecticut Valley have their differences. Nearness to the ocean has its effect in the former case, moderating the temperature somewhat in winter, and slightly checking excessive heat over extended periods in summer. But when southeastern Massachusetts is considered, yet another difference is found. Here the influence of the Gulf Stream as it sweeps northward modifies the winter and lengthens the fall, preventing frosts until much later than only a few miles farther inland.

The Gulf Stream is itself a somewhat variable factor. From time to time its course changes, sometimes swinging in quite close to the land, while at others it turns more out to sea, thus having less effect. In general, however, the result is that crops normally grown only much farther south can be successfully raised on Cape Cod and along the shore towns of the southern part of the state, besides insuring safety to late planted crops coming onto the market after the regular season has ended.

Small factors sometimes prove to be of considerable importance in establishing the limits of life zones, and this is illustrated by the Holyoke range of mountains in the Connecticut Valley. This range is by no means a continuous one, but its general trend is across the valley with an average height of perhaps a thousand feet. In spite of its numerous breaks which would seem to render it of no importance as a line of separation, we find many forms of life extending from the south as far as this range but no farther, and the season on the northern side of the range is about ten days later in spring than on the southern side. The steep

northern slopes of the mountains are well covered by snow during the winter, and this is not quickly reached and melted by the sun in the spring, thus delaying the season north of the range. During the winter, too, increased cold results, and it is probably this which prevents a farther northward spread of the forms which reach the southern slopes, by establishing a winter temperature which they are unable to withstand. During the summer, northward migrations can and sometimes do occur, but the cold of the winter following is always sufficient to destroy these marginal settlements, leaving the northern limit of occurrence of these forms where it was before.

Closely related to the questions of distribution of our native animals and plants, are those of introduced forms of life. The Elmleaf Beetle, which reached this country nearly three-quarters of a century ago at Baltimore, has now spread far to the northward, and how much farther it can go is a question of considerable importance. It thrives in the Upper Austral Zone, but is noticeably absent in the highlands of the Pennsylvania mountain region, though it is present again west of them. To the north it has caused serious loss to the elms of New England, resulting in the appropriation of large sums for spraying of the trees to protect them from its ravages. Careful studies of this pest in Massachusetts show that while a serious menace to the life of the elms in the southern part of the state and in the river valleys, it becomes of little importance in the higher and northern parts, and many towns which formerly appropriated money for the protection of their elms from this insect have now learned that this was unnecessary, as the trees would suffer but little at most, in any case.

With the San José Scale similar facts are now coming to light. This pest finds the best conditions for its life in the Lower and Upper Austral Zones, where it has caused the loss of many millions of dollars. Even in the Upper Austral territory of Massachusettes, it is one of the most destructive enemies of the fruit-grower. As we pass into the Transition Zone, however, its ravages become less severe, and by the time the centre of this zone has been reached, it is of only medium importance. In this case, it has seemed to those studying this problem that this insect was originally limited by the Upper Austral, but has gradually acquired some degree of resistance to lower temperatures and has thus been able to extend into the Transition Zone. Whether this resistance of cold will continue to develop until it becomes a serious insect in this entire zone is a question which cannot now be answered. At least, it points out the possibility of the acquirement of resistant qualities as a factor which must be taken into consideration. The speaker has watched with much interest a small colony of these insects which about fifteen years ago was brought on nursery stock to a point near where the Transition Zone meets the Canadian. Here from year to year the insect has reproduced just sufficiently to maintain itself, doing no injury, and "eking out a miserable existence" and nothing more.

The Asparagus Beetle and numerous other examples might here be considered as illustrating the significance of life zones in their relation to the limits of spread of our insect foes, but time for their consideration is inadequate.

With life zones divided by mountain ranges we find that it is not usually the case that the same forms occur on both sides of the barrier. When this does happen, two explanations offer themselves. The barrier may be a recent one, at least geologically speaking, having arisen after the zone had been occupied by the forms concerned. Or the barrier may be a less complete one than it was supposed, and these forms have in some way succeeded in crossing it. More often the animals on the two sides are not the same, though they may play similar parts in Nature's economy.

and again two explanations are possible. Where two similar but different forms occur, one on each side of a barrier, it has been suggested that a common ancestor of the two had established itself over the entire zone before the barrier was formed, and that development on the two sides since has been along sufficiently different lines to produce different species. The Peach Borer east of the Rocky Mountains, and its close relative, the Pacific Coast Peach Borer, on the western coast, are considered an example of this. Many forms, however, show little close relationship but much similarity to Old World forms, and here geology steps in to provide an explanation.

There is much evidence that in past ages the northern part of the world's surface was much warmer than it now is, and also that there were more or less complete land connections between Europe and North America on the east, and Asia and Alaska on the west. It is noticeable that many forms of life in the north-eastern part of this country find their closest relatives among European forms, and similarly that many of our western forms closely resemble those of North-Eastern Asia. From these facts it seems at least probable that differences in the life of the same zone found on two sides of a north and south barrier may be accounted for as being the results of migration from the two opposite ends of the Eurasian continent.

Life zones then mean, not the areas continuously inhabited by a certain list of forms, but territory having fixed standards, which meeting the needs of animals and plants, able to live under such standards, can be populated by them if means of access is provided.

It has been said that certain places in Africa are perfectly fitted for some American forms of life. If this be correct, such American forms once placed there would establish themselves and thrive in their new home, the only difficulty being that of getting them across the ocean in the first place. This may remain a difficulty for years, but, so far as North America is concerned, the arrival of new forms from other countries is not only possible, but is actually occurring, and if favorable conditions are found on arrival, or, in other words, if proper life zone conditions and proper food are at hand, the establishment of new animals and plants in our land is certain.

Some of these arrivals in the past have been desirable, but certain it is that many have proved veritable pests. It is stated that about seventy-five of our one hundred worst insect pests are of foreign origin, and, in spite of all systems of inspection and care, new ones somehow creep in and establish themselves before we are aware of their presence.

To prevent this seems hopeless under our present methods, and the recent development of the nursery business, bringing in millions of all kinds of plants from all parts of the world, harboring insects many of which it may be difficult or impossible to find by any inspection, raises the question whether it would not be wise to absolutely prevent the importation of all plants from foreign countries, in order to protect ourselves from the pests of other lands which otherwise might join forces with those already here, in the destruction of our crops.

MORNING SESSION

FRIDAY, November 5th.

THE PRESIDENT: The meeting is now called to order and I intend to postpone the first item on the programme, that is, "Election of officers, etc.," and instead to ask Mr. Morris to read his paper on "Fresh Woods and Pastures New."*

Mr. Morris's paper was read.

DR. HEWITT: I am sure I am voicing the sentiments of the whole meeting when I say how pleased we are that Mr. Morris was able to come to this meeting and deliver one of his charming papers. It occurred to me, as Mr. Morris was reading his paper, what a pity that he could not be given charge of an expedition such as Bates had in South America, what charming accounts of those entomological journeys we should have when Mr. Morris returned. This paper is now open for discussion, if any of the members care to ask Mr. Morris any questions regarding his captures.

I hope, Mr. Morris, that you will take this silence as indicating that your paper was so fully detailed by you that no one wishes to discuss it. We will now pass on to the next paper, by Professor Lochhead, on "Some Notes on Nose and Other Bot Flies."

SOME NOTES REGARDING NOSE AND OTHER BOT FLIES.

PROF. W. LOCHHEAD, MACDONALD COLLEGE, QUE.

1. NOSE FLIES.

In connection with the "Farmer's Friends and Foes" department in the *Family Herald* and *Weekly Star* several interesting letters were received by me from the West regarding *Nose Flies*. I consider the information obtained of sufficient importance to bring before this meeting, for it became evident when I looked up the literature available that entomologists as a rule have much to learn regarding this group of flies.

The correspondence referred to began innocently enough through a question asked by a Saskatchewan subscriber; "Does the Nose fly that torments horses in summer time sting or bite the horse, or what makes them so afraid of the flies?" I replied as follows:—

> Nose flies are a species of horse bot flies and have a peculiar habit of laying their eggs round the lips of horses, and the nostrils. For this reason they have been termed "Nose Flies." We all know that horses have an instinctive dread of this fly, and seem to recognize its presence. While these flies may appear to sting, they cannot do so, for they have no sting. Their mouth parts are aborted. However, this fear of the bot fly has been bred into the bone of thousands of generations of horses, who have suffered the effects of the bots in the stomach. There may be something in the fact that the bot fly resembles a wasp or a small bee and that the horse cannot very well distinguish between these insects which sting and the bot fly which does not sting. Personally, I am of the opinion that horses know instinctively that this insect is harmful to them. There are many things that we cannot explain, and this instinctive dread of nose bot flies is one of them.

*This paper will appear in the *Canadian Entomologist*, Vol. XLVIII, No. 5, May, 1916.

My reply led another Western reader to make a spirited reply to my statement that the bot flies cannot sting either with its mouth-parts or with its ovipositor. He says:—

My experience with "nose flies" that annoy horses dates back eight years. Previous to that time they were unknown in the district. A bunch of horses were brought in from the United States the year before and from them I think we obtained this pest. Of course we always had the long-tailed bot-fly, but this bob-tail is a curse both to horses at work and in pasture. Work horses can be given some protection in the shape of nose covering, but the poor horses outside cannot even feed in the daytime for them. If you could see the poor beasts huddled up together stamping, rubbing, etc., I am sure you would not think the laying of an egg by these pests so simple a matter. Come and hitch up a six-horse outfit without any protection sometime this coming summer and you will change your mind. Anyone who will take the trouble to examine these bob-tail bot flies will notice on the tail end a pair of tweezers when pressed slightly. It is from these tweezers the trouble arises.

In my reply to correspondent No. 2 I suggested that perhaps the real culprit was a Tabanid for these insects are known as Gad-flies, Breeze-flies, Greenheads and Ear-flies, but asked for specimens. Correspondent No. 2 was good enough later to send a few specimens of the Nose flies and made further observations regarding their habits:—

These pests have been some weeks later making their appearance this year, owing I presume to the late frosts. I think the description you once gave, namely, red-tailed bot-fly, was fairly accurate, but strange to say I have looked very closely for their eggs but have failed to find any—so different from the ordinary long-tailed bot, which distributes its eggs promiscuously. On squashing an ordinary bot fly one finds numberless eggs, but in these I have failed to see any. The habits of these nose flies are to hover around a foot or so above the earth, when they make a dart upwards and try to hit the horse on the lips or nostrils; it also seems to dig its hind part similar to a bee or wasp when stinging an object. It rarely hits but once at a time, when it seems to disappear for a few seconds, then comes again. I have examined its rear end for stinging apparatus, but can only see what to me appears a pair of tweezers. We have all the other kinds of horse flies you mentioned, but a horse will calmly endure being chewed up with the spotted winged horse flies, bull dogs and the rest of that family, but let one of these nose flies strike and he is up in the air at once and has to rub his nose on something or other. As I mentioned in my previous letters it is only a few years since they made their appearance in this district and I have heard that there are parts of this province where they have not yet made their appearance. They are the greatest pest we have got on horses. I think the Royal Humane Society should get busy and make all owners provide some building in which any stock in pasture could go in for protection. I have a pole and straw shed which I put up for winter and the straw has settled down a little, which leaves an air current at the top of walls. My stock appreciate it and it is also a protection from the bull dog flies, too, which are a great annoyance to cattle as well as horses. These nose flies don't touch cattle.

My reply was as follows:—

We were very glad to get four specimens of nose flies from Saskatchewan, for their arrival sets at rest the question of the identity of the flies that bother the horses so much in the western provinces. They are nose flies (*Gastrophilus nasalis*), and are one of the species of horse bot-flies. Now our friend S. H. differs from us on the power of stinging these nose flies possess. We maintain that these flies do not and cannot sting, for they have no stinging appliance. In all kinds of flies that sting the mouth-parts are modified to form a stinging or piercing apparatus; on the other hand, in all the kinds of bees and wasps that sting the egg-depositor at one hind end of the body is modified for piercing purposes. Now, as bot-flies are true flies we would naturally expect their mouth-parts to show piercing appliances if they can really sting, but examination reveals no such appliances. Moreover, the egg-depositor at the hind end of the body is rather long, but it is too soft and flexible to serve as a stinging instrument.

If these bot or nose flies cannot sting, why do they cause such panic among horses? The answer is, we believe, the persistent efforts of the flies to deposit their eggs on

the hairs of the front legs. They resemble a bee or a wasp to a considerable extent, even to the humming noise, and their sudden darts coming continuously and persistently get on the horses' nerves and set up a panicky state of mind. The cattle or warble or bot fly is another instance where a fly that cannot sting causes cattle to go careering through the fields in a panicky condition. The real biting flies like the horse fly do not seem to produce the same effect, for the reason we suppose that once the horses get rid of it they have rest for a while. There is no doubt as to the name of the flies sent, and it is also certain that they do not sting. Three of the specimens submitted were males, hence would not have eggs.

Later still, a third correspondent from Saskatchewan writes me regarding Nose flies and gives further particulars as to the differences between the Nose fly and the Bot fly. He says:—

I have been reading in the issue of July 28 an article on nose flies. As the nose flies are a very troublesome pest among horses, I would like to add my mite of knowledge concerning them. Now they cannot be the same flies that deposit their eggs on the legs because they are much smaller and darker in color, and the mode of laying the egg is different; the ordinary bot-fly keeps buzzing and depositing her eggs (which are yellow) continuously; whereas in the nose fly it strikes upward swift and wickedly and then disappears, to return again possibly in half a minute; the egg is black. One fellow struck me on the back of the hand last summer and left an egg which attached to a hair; there was no pain, though the wicked way it does the trick is quite enough to scare a person or a horse either. When there is protection on the nose of the horses (rags are commonly used and wire screens are sold to cover the nose), they will strike at the person; often I have had them hit the underside of the brim of the hat.

My reply was as follows:—

The correspondence regarding nose flies has brought out much important information regarding these pests. Our friend (W. B.) tells us something really important in the way of distinguishing two kinds of bot flies of horses. It is likely, however, that there are at least three kinds of bot flies in the West, and this fact will account for the difference noted by the various observers. There is first of all the "common bot fly," which deposits its yellowish eggs on the legs and is of a general reddish brown color. The eggs may be deposited on the fore legs, knees and shanks. A second form is what is known as the "nasal fly," specimens of which we identified in our last note on nose flies in these columns. We beg to note a clerical mistake which we made in stating that they deposit their eggs on the hairs of the front legs; this should have been "on the hairs of the lips and the margins of the nostrils." This insect is smaller than the first, has white eggs and is of a darker color, but still with a considerable number of brownish hairs. The third form of bot fly is the "red-tailed bot fly." This has about the same general color as the nasal fly, but is not so large and deposits its eggs on the lips of the horses. The eggs are darker than those of the first or second. It must not be supposed, however, that the "red-tailed bot fly" is the only red-tailed bot fly. A confusion may arise here; there are different bands of color on the abdomen of both the nasal and the red-tailed bot fly, the bands being very much alike in both—a yellow band in front, black in the middle and orange on the last. The term "red-tailed bot fly" is, therefore, not a good one to use, because the nasal bot fly is also red-tailed. These facts regarding the three forms of bot flies may account for the differences observed by our correspondent, as we have already stated. There are other differences, of course, which are revealed on close examination under a magnifying glass or a microscope, but the foregoing are sufficient to identify them. We should be very much indebted to our readers in the West if they could send specimens of bot flies to us so that we may be able to give further information when questions are answered.

A fourth correspondent at this time contributes his mite as to the best treatment against nose flies:—

There is an objection to the use of rags tied over the horse's nose on account of difficulty in breathing. I have tried the following remedy with much success: Mix about 10 cents worth of oil of tar in machine oil (but other oils would be better), and wipe lightly around the muzzle of the horse—but use it very sparingly—whenever flies make an attack. I keep a bottle among the implements and flies never come near the horses. Mosquitoes dislike this substance also.

A fifth Saskatchewan correspondent writes as follows:—

I would like to add the following information, which I will vouch for being correct. The nose fly appeared in this district some ten years or more ago, brought I expect from the States or Mexico. In size, shape and color it closely resembles the bot fly, and is often mistaken for it, but it is a trifle smaller and more grey. The principal difference, however, to the horse and stockman lies in its method of depositing its eggs. The bot fly buzzes incessantly up and down the animal's legs, sticking a yellow-white egg on the hair every other moment, mostly below the hock or knee. In distinction from the bot fly, the nose fly uses its ovipositor like a hypodermic needle. It flies very swiftly back and forth, poises itself for a moment as though to judge place and distance, and then, darting upward, stabs a *black* egg into the lip or chin of the horse and retreats as swiftly, only to return at the next suitable moment. The horse can hear it and awaits the attack with nervous apprehension. On feeling the needle-like thrust it starts violently and rubs its lips or nose on the grass or against another horse. Often horses on the range will be seen standing with their noses buried in each other's manes or resting on another's back. I never saw a nose fly draw blood, and I think the "ear fly" referred to in the article is a very small grey-black fly that bites principally in the ears, across the chest and around the sheath. These are distinct from the flies, like very diminutive house flies, which congregate around animals' eyes. There is also the "deer fly," about the size of the house fly, but having a speckled or mottled appearance, whose wings when at rest stand out, giving it a triangular shape. Also the huge fly as big as a wasp, locally known as the "bulldog." The latter flies bite with nippers and generally draw blood. There is also another pest called the heel fly which I have not studied yet. Some people claim it is identical with the nose fly. It attacks the heels of cattle, which take refuge in water when possible. It is a common sight to see one or more individual animals break from a bunch or off the feeding ground and stampede for water, brush or, when neither is handy, a buffalo wallow or washout. Animals will be found thus upwards of a mile from any other cattle. In a country so large, individual attempts to destroy any of these vermin seem hopeless; but if any means could be devised to co-operate for their destruction, the relief would be tremendous both to man and beast. Of all the flies the "nose fly" is perhaps the worst, and we have to use some kind of porous net over our horses' noses, as referred to in the quoted article.

A reader from Alberta (Correspondent No. 6) writes as follows:—

I have been very much amused and interested at your articles on nose flies and bot flies. I imagined that every farm boy of an inquiring nature and over ten years of age knew all there was to know about those little pests. I have been a neighbor of theirs for the past thirty years and consider I am about as well acquainted with their habits as the ordinary man. I was a boy of thirteen when I first made the nose flies' acquaintance. I used to lead an old blind horse to the cultivator; on calm, hot days the horse would suddenly stand on his hind legs and start pawing the air with his front feet, sometimes bruising me in his flurry, so I naturally started in to investigate with a boy's curiosity, and the only thing I could notice for a while was a dark object about the size of a buckshot come from somewhere near the ground, strike the horse on the lip and immediately fall to the ground. One thing I noticed in particular was that when they struck the horse they were upside down and their tail struck in advance. My idea was that they were a variety of bee. The first one I caught I examined very closely for a sting but could not find any; then I started to squeeze the rear end to see if there were any eggs in the oviduct and did not find any eggs, but to my surprise I squeezed out two stings just below the oviduct shaped exactly like the mandibles of an ant, but considerably stronger and sharp as needles. So I came to the conclusion that was the cause of the horse's antics. The nose flies that I was acquainted with in the East were about the size of a house fly but shaped like a bee. You say that only bees have stings in the tail, and I believe you are right; but when you claim that a nose fly is a bot fly I think you are off. The nose fly is one branch of a large family of stock bees, and the bot fly may also be a branch of the same family, but it is the only one that lays the yellow egg which hatches into the bot inside the horse's stomach, and it will lay eggs on a horse from heels to ears and sometimes on cattle. It appears to be the strongest flier of any of the family and also the best known. Since coming to Alberta I have made the acquaintance of several other members of the stock bee family. First I will mention the brown-tailed light yellow nose fly; it is about the size of a blue-bottle fly but shaped like a honey bee. It also carried heavy mandibles just below the oviduct; they are sheathed in the body and cannot be seen unless the body is pressed between the thumb and finger, when they expose themselves.

Then there is another with a light yellow body, about the size of the female bot, which I imagined was the male bot; it also has a pair of mandibles, but they are frailer than those on the nose fly.

Now we get to the heel fly, which belongs to the same family and is the largest of the family that I know. It is about the size and shape of a small honey bee and carries the heaviest set of mandibles of any of the stock bee family; it is also the poorest flier; it hovers around in the grass or near the ground on calm, hot days, and darts up, striking the cattle on the first place it reaches, generally from the heels up to the hocks and sometimes on the rump; then up goes the animal's tail and it bolts. If there is a four wire fence in front of the animal it goes right on through, while the fly calmly drops to the grass and sails along until it comes to the next cow or steer, which also throws up its tail and has business elsewhere. By that time all the cattle have taken the hint and disappeared.

Another one I captured near the horses one day about as large as the heel fly and the same color; the only difference I noted was that its mandibles were jet black and very strong, while all the rest were brown. One thing I noticed with all of these insects is that they are always worse on hot, calm days and are very weak fliers, never appearing when there is any wind, excepting the bot which is with us all summer.

A correspondent (No. 7) from Chatham, Ont., writes:—

I think your correspondents of July 28th and September 1st are in error about what they call nose flies, as the flies do not strike on the horse's nose but underneath, just back of the opening of the jawbone. I have caught scores of them by placing my hand beneath the horse's chin. They do not deposit eggs, as they are males of the common bot fly. The eggs that are on the lips were not deposited there, but adhered when the horse was rubbing his legs, as the horse does not use the tongue for that purpose. The difference in colour of eggs can be accounted for in this way. When first deposited they are yellow, but turn darker until hatched; then the shells which still adhere to the hairs get quite light.

2. Warble Flies.

For the last two or three years reports have reached us from Chateauguay and Huntingdon Counties that certain flies were very troublesome on the dairy herds in pasture during June and early July. It was asserted that they stung the cattle and chased them about the fields. This summer a specimen of the pest was sent me, and on comparing it with type specimens of Warble flies sent me by Dr. Hadwen, of British Columbia, I identified it as *Hypoderma bovis*. Dr. Hewitt, to whom I submitted the specimen, corroborated my identification.

The explanation of this outbreak of *bovis* in the Chateauguay-Huntingdon district is clear when it is known that a large importation of cattle from Scotland has occurred annually for many years. The breeders of this district admit that warbles on the backs of the cattle are more common now than they were a few years ago.

Following is a table which may be of service in identifying the common genera and species of the Oestridæ.

Oestridae.

(*Bot Flies.*)

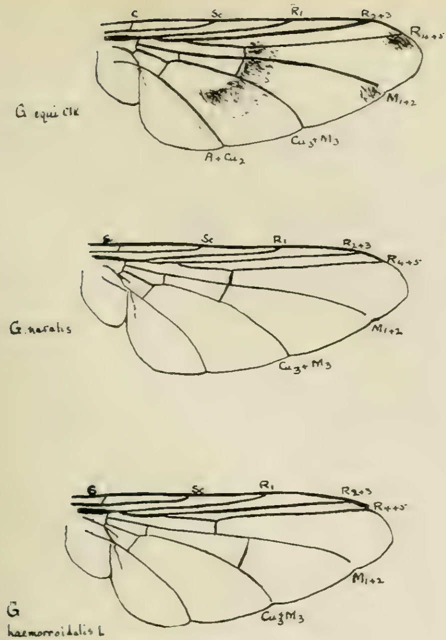
Common genera and species:

a. Costal vein ends at tip of R4+5; M1+2 is straight, not reaching the margin, and cell R5 wide open; squamae small, arista bare; ovipositor elongate. *Gastrophilus.*

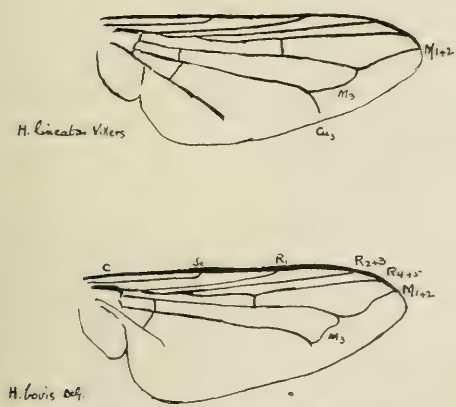
b. Wings with spots and smoky median cross band. *G. equi* (horse bot fly).

bb. Wings without spots.

c. Posterior cross-veins (M-Cu) beyond the anterior cross-vein (R-M); legs blackish brown. *G. hæmorrhoidalis* (red-tailed bot fly).



Wings of *Gasterophilus.*



Wings of *Hypoderma ilneata* and *H. bovis.*

cc. Posterior cross-vein opposite and nearer than the anterior cross-vein. *G. nasalis* (nose fly).

aa. Costal vein ends at tip of M1+2; M1+2 with a bend; cell R5 much narrowed or closed.

b. Facial grooves approximated below; cell R5 closed and petiolate. *Oestrus*.

bb. Facial grooves far apart; squamae large, ovipositor elongate. *Hypoderma*.

c. Prothoracic band of yellow hairs, mesothoracic band of brownish black hairs; media 3 sinuate; legs black with black hair; tips of hind tibiæ and tarsi yellowish brown. *H. bovis*.

cc. Thoracic band of hairs brownish; media 3 rounded; tibiæ and tarsi yellow; femora black. *H. lineata*.

The President: We are pleased to have Professor Lochhead's paper in our Proceedings, because this is a group of insects which is gradually coming to the front more and more. It is very apparent that, both in the case of the Nose Flies attacking horses and in the case of the Warble Flies attacking cattle, these insects are becoming far more frequent. Our own correspondence files would display a somewhat similar series of letters as Professor Lochhead has read here, and the farmers who write to us about these things are very confident about their own observations and their own knowledge, as a rule. In regard to a brief note that Professor Lochhead mentioned about warble flies, I believe what he says is quite true, that we can trace the increasing prevalence of *Hypoderma bovis* in this country to the importation of cattle. In the old days the only species recognized in this country was *Hypoderma lineata*, which was considered to be a truly native species, but more recently, owing to the investigations of Dr. Hadwen in British Columbia and my own enquiries from the Branch here, we were able to show that *bovis* occurred in this country in addition to *lineata*, and further that *bovis* was pretty widely distributed, particularly in the Province of Quebec, and it is on this suspicion that Dr. Hadwen has based most of his very valuable investigations, but before passing on to this paper I think there are a number of points in Professor Lochhead's paper which might be discussed. We might discuss the two papers together.

Prof. Lochhead: Since the two papers deal with almost the same subject, I think it would be preferable to have the discussion on the two papers at the same time.

Dr. Hewitt: We shall now have Dr. Hadwen's paper entitled "Further Notes on the Warble Fly, *Hypoderma bovis*."

Read by Mr. Treherne.

THE SEASONAL PREVALENCE OF *HYPODERMA BOVIS* IN 1915, TOGETHER WITH OBSERVATIONS ON THE TERRIFYING EFFECT *H. BOVIS* HAS UPON CATTLE, AND LESIONS PRODUCED BY THE LARVA.

Seymour Hadwen, D.V.Sci., Agassiz, B.C.

The observations and experiments on *H. bovis* which were conducted at Agassiz this year, are all preparatory to the work which is contemplated for next year, on the prevention of egg laying and destruction of larvæ.

A previous paper has been written on the seasoned prevalence of *H. lineatum*. It is remarkable that so little is known about the seasonal activity of these flies,

and if any treatment is to be undertaken it is absolutely necessary to know when they come and go. As I have already pointed out, the statements made by the European writers about the length of the season, especially for *H. lineatum*, are very vague.

The following table gives a complete record of the observations. The cattle, ten in number, were kept in a field directly in front of my laboratory. The animals were under almost constant observation. Whenever they were seen running, either myself or assistant went out to look for flies. If flies were noticed in the morning, then no further trouble was taken for that day. It is of course possible that we may have failed to observe them on some occasion or other, but this seems hardly likely, seeing that *H. bovis* invariably causes alarm among cattle.

The most likely error made was in the catching of flies, but these were mainly caught when they were abundant. It may be that on one or two occasions the flies which were taken would have lived over night and attacked the cattle on the following day. The only dates on which this may have occurred was on June 15th and 22nd. The meteorological records were kindly supplied by Mr. Moore, Superintendent of the Experimental Farm. In comparing them with my records, I was delighted to find that the changes of temperature coincide almost perfectly with the appearance and disappearance of the flies.

THE SEASONAL PREVALENCE OF HYPODERMA BOVIS IN 1915.

June.		Sunshine.		Rain.	Temperature, °F.	
		Hrs.	Min.	Inch.	Max.	Min
1....	Cattle quiet, no flies..................	5	42	.47	64	48
2....	" "	1	48	......	62	49
3....	" "	2	54	......	72	42
4....	" "	11	06	......	78	43
5....	Flies seen, cattle running............	11	54	......	82	50
6....	1 *H. bovis* taken......................	7	24	......	81	52
7....	Cattle quiet, no flies..................	2	00	......	65	47
8....	" "	Dull		0.8	64	46
9....	" "	1	18	......	64	51
10....	" "	5	30	......	59	45
11....	" "	......	18	.6	58	46
12....	" "	1	00	.35	64	51
13....	Flies seen, cattle running............	......	18	......	67	50
14....	1 *H. bovis* taken......................	4	30	......	70	53
15....	Cattle quiet, no flies..................	8	36	......	78	55
16....	" "	2	42	......	67	51
17....	" "	Dull		.65	64	50
18....	" "	......	54	.06	62	46
19....	" "	Dull		.05	64	47
20....	1 *H. bovis* taken......................	5	54	......	67	45
21....	5 *H. bovis* taken......................	11	48	......	81	43
22....	2 *H. bovis* taken......................	11	42	......	82	43
23....	Cattle quiet, no flies..................	1	06	.02	74	46
24....	Flies seen, cattle running............	3	24	.03	78	46
25....	" "	2	12	......	76	45
26....	Cattle quiet, no flies..................	Dull		.05	70	47
27....	1 *H. bovis* taken......................	3	42	......	76	46
28....	6 *H. bovis* taken......................	9	24	......	80	43
29....	Flies seen, cattle running............	11	36	......	84	48
30....	2 *H. bovis* taken......................	10	48	......	91	49
July.						
1....	Flies seen, cattle running............	11	36	......	93	56
2....	" "	11	42	......	89	55
3....	Cattle quiet, no flies..................	11	18	......	84	56

THE SEASONAL PREVALENCE OF HYPODERMA BOVIS IN 1915.—*Continued.*

July.	—	Sunshine. Hrs.	Sunshine. Min.	Rain. Inch.	Temperature, °F. Max.	Temperature, °F. Min.
4....	Flies seen, cattle running............	10	48	......	82	59
5....	" "	4	42	.03	77	52
6....	Cattle quiet, no flies.................	1	42	.18	76	55
7....	Flies seen, cattle running............	9	18	.02	84	43
8....	Cattle quiet, no flies.................	6	6	.25	70	44
9....	1 *H. bovis* taken.....................	5	48	......	69	44
10....	Flies seen, cattle running............	6	00	......	71	42
11....	" "	......	36	.04	68	40
12....	Cattle quiet, no flies.................	2	30	.16	70	43
13....	" "	Dull		.08	69	41
14....	" "	Dull		.02	68	42
15....	" "	Dull		.58	64	40
16....	Flies seen, cattle running............	2	12	......	66	47
17....	" "	5	18	......	70	46
18....	Cattle quiet, no flies.................	6	00	......	79	34
19....	" "	11	06	......	88	42
20....	Flies seen, cattle running............	11	54	......	95	56
21....	Cattle quiet, no flies.................	11	36	......	84	50
22....	Flies seen, cattle running............	11	30	......	78	49
23....	Cattle quiet, no flies.................	11	10	......	81	46
24....	" "	10	54	......	86	48
25....	1 *H. bovis* taken.....................	10	06	......	76	49
26....	Cattle quiet, no flies.................	Dull		......	70	49
27....	" "	......	36	.05	71	56
28....	" "	......	30	.02	72	58
29....	Flies seen, cattle running............	2	42	......	77	58
30....	" "	5	30	.08	75	56
31....	Cattle quiet, no flies.................	5	00	......	72	55
Aug.						
1....	Cattle quiet, no flies.................	7	08	......	78	52
2....	" "	6	08	......	76	50

No more flies seen for the rest of the season, nor were the cattle seen running.

SEASONAL ACTIVITY OF H. BOVIS AT AGASSIZ.

In 1912, *H. bovis* was first noticed on June 8th, and the last appearance was on Aug. 2nd, a total of 55 days.

In 1914, *H. bovis* appeared on May 31st, and none were recorded after July 27th. On this latter date, the flies were seen attacking the cattle at 6.30 p.m. Total 57 days.

In 1915, the flies were either seen or caught on 28 days, from June 5th to July 30th, a total of 55 days. The height of the season was from June 20th to July 11th.

These observations coincide closely with the pupal period and with the time the last larvæ emerge from the backs of cattle; both at Agassiz and in Europe.

EMERGENCE OF LARVÆ.

Carpenter (1915) says that most of the maggots emerged from May 27th to June 17th, "while a belated one occurred several weeks afterwards on July 3rd."

In my own article (1912) I recorded the last larvæ of the season on July 2nd.

Lucet (1914) says, "Sur 79 que j'ai recueillies, 24 l'ont été du 16 au 31 mai; 53 du 1er au 30 juin; 2 au début de juillet, époque a laquelle mes sujets d'expérience en furent débarrassés."

Pupal Period for H. bovis.

Miss Ormerod (1900) puts the pupal period at 25-36 days = 32.5 days.

Carpenter (1908) at 31-32 days. (1914, about 8 weeks. Not included in average).

Hadwen (1912) at 34.7 days.

Glaser (1913) gives an average of 44 days.

Lucet (1914) records an average of 32.5 days.

Averaging all these records gives a result of 35 days.

If then, the last larvæ emerge about the first of July, the season for flies cannot extend far into August, and my records show this to be the case.

The Effect of Temperature on the Pupal Period.

I have already shown (1914) that if the pupæ of *H. lineatum* are placed in an incubator that the fly will emerge in as short a period as 13 days. This year I placed several larvæ of *H. bovis* in an incubator kept at 80°F. The pupal period was shortened to 17.4 days.

Pupæ Kept in Incubator at 80°F.

					Period.
2 larvae pupated	May 1st......	Emerged	1* 1†	May 19th........	19 days.
3 " "	3rd	"	3	" 20th........	17 "
1 " "	4th	"	1	" 20th........	16 "
1 " "	5th	"	1	" 21st........	16 "
2 " "	6th	"	1	" 22nd........	18

As the temperature at which the pupa is kept causes early or late emergence, the situation in which the larva finds itself on leaving its host will make some difference also. An experiment I hope to carry out next spring is to place some pupæ in a situation such as the edge of a manure-pile; here the larvæ would derive heat much in the same way as if placed in an incubator. Others must find crevices in the floors of stables, etc., where they would be warmer than out of doors. These warm situations would mainly favor *H. lineatum* and the early larvæ of *H. bovis*. Later in the season, when the sun is stronger in June and July, I do not think the places the larvæ choose to pupate in can matter so much. But early in the year it is quite possible that some of the early appearances of *H. lineatum* may be accounted for in this way.

An Experiment made to prove how *H. bovis* engenders Fear in Cattle.

July 1st, 3 p.m. Two calves which had been kept inside since they were born, were turned out into a small paddock. The cattle which had previously occupied the paddock, had just been put into the stable, and the flies had been chasing them a few minutes before. The two calves on being liberated at once began to caper about and run as calves will after they have been confined. Finally they came to a halt just in front of me. They stood there panting. A moment or two later I saw a single *H. bovis* attack one of the calves. It struck several times before it was noticed. Finally I saw the calf give a kick or two, then it turned its head round to see what was annoying it. There were some more kicks and stamps, then the calf began to move away, its tail went up and it began to run and finally to gallop. The other calf remained standing for a short time

* Male. † Female.

after the first one left, but soon went through the same antics as the first. Both calves ran erratically about the paddock; they finally discovered a barrel used for watering the cattle; they both tried to get into it at once, and I was fortunate in securing a photograph of them in this position.

The flies (there were, I should judge, three or four in the field) kept on striking even when they were in the barrel. Later the calves found a corner behind some boards, there they lay perfectly quiet with their noses stretched out straight in front of them on the ground. Occasionally a fly would find them, they could stand the fly striking perhaps half a dozen times, but then, suddenly, they would get up and run as if possessed.

I have noticed the cows endeavoring to hide from the flies just in the same way. If they could find the least bit of shade along a fence or building, they would lie there quite motionless, until roused by the repeated attacks of the fly. In some cases cattle lie down also from exhaustion.

This experiment was also witnessed by Mr. Moore.

Calves attacked by *Hypoderma bovis* trying to get into a barrel of water.

Hypoderma bovis sitting on fence, waiting to attack cattle.

In my first paper of 1912, I gave my reasons for cattle being afraid of *H. bovis.* I quote the following: "It is this clumsy, persistent attack which I believe frightens cattle, and I would suggest that probably it is this cause which makes cattle stampede or 'gad.' When the *Tabanidæ* (or other flies) attack an animal and cause annoyance, the cow simply flicks her tail or brushes off the fly with her tongue, and feels that she has control or can get away from the insect. But a Warble fly comes buzzing along, strikes a time or two, and when the animal it is attacking kicks or stamps, it comes back just the same. Then the animal begins to lose its head and runs away, and when it still finds itself followed becomes wild with terror."

There have been so many false theories advanced for the fear which these flies engender, that I feel licensed to go fully into this question.

The commonest theory is that cattle are afraid of the fly because of its resemblance to a bee. The experiment just quoted refutes this entirely, because the calves had never seen a bee. Another idea is that cattle fear the fly because they are aware that it will cause them future trouble. This idea must have come from someone who thought that cattle were endowed with especial intelligence.

The only theory which all entomologists now agree upon is that the old idea of the fly causing pain is wrong, seeing that it has no organs capable of piercing the skin. Some authors claim that other insects as well as Warble flies cause cattle to "gad."

This is also entirely wrong, and can be refuted in several ways. For instance, I saw *Tabanidæ* and other flies worrying the cattle this year long after the last Warble fly had left, and did not see any of them stampeding. Besides as I have pointed out cattle only run one or two at a time from other insects. They merely show anger and not fear, when they run into the bushes or dust themselves. With *H. bovis* the fear is undoubtedly contagious. The only time I think it is permissible to make a mistake, is when cattle are at play, when they often run with their tails up. Or when, for instance, a steer has been roughly handled and dashes wildly into the middle of a herd of cattle, then one sometimes sees a stampede. In other words if a cow gets really frightened from any cause and runs, then those near her will often follow, and the fear spreads. This is exactly what takes place when an animal is chased by *H. bovis*.

The great difference between *H. bovis* and *H. lineatum* is in their effect upon cattle and in their methods of oviposition. I have shown that *H. lineatum* may not even be felt when it lays its eggs while resting on an animal's foot or on the ground. When it does grasp the hairs to lay eggs for instance on the hock, it does so gently, otherwise it would be brushed off before it had time to lay several eggs on the same hair.

H. bovis is rougher and clumsier in its attack and as it only lays one egg at a time, it can do so regardless of the fact that the animal may be kicking or running.

The Penetration of the Skin, and the Lesions Produced by the Larva of *Hypoderma bovis*.

Hewitt (1914) saw three larvæ of *H. bovis* work their way into the skin of a calf. I have not been fortunate in seeing the penetration of the skin by these larvæ, but can confirm Hewitt's observation in another way, by showing lesions on the skin of cattle, over which were found the eggs of *H. bovis*.

I have already described the skin lesions produced by the larvæ of *H. lineatum*, and of the disease caused by them, for which the name of *hypodermal rash* was proposed. The penetration of the larvæ was proved in three different ways—by removing bits of skin from cattle and placing larvæ upon them, by finding a larva in the act of passing into the skin of a cow, and finally by expressing two larvæ from the skin of an animal which I had under observation. The passage of the larva in *H. bovis* was proved by cutting circles in the hair round new laid eggs, and later, after the eggs had hatched finding the swellings underneath.

The swellings are somewhat different from those caused by *H. lineatum*. There is not so much exudation of serum, and they seem rounder and more raised. They are usually about half an inch across, but if several eggs are laid close together the swellings may merge. The explanation of the difference in the character of these lesions, is because in *H. bovis* the eggs are laid singly. In *H. lineatum* it is most likely that several larvæ choose the same follicle for entrance, seeing that a number of eggs are attached to the same hair. In my experiments I also noted that the eggs nearest the skin hatched first, due no doubt to the animal heat and to their having been laid first, and it would appear probable that the larvæ follow one another through the same opening. The result

would be a larger opening than the single larva of *H. bovis* could make, consequently a bigger flow of serum. The swellings in the case of *H. bovis* are sometimes quite large, but there is not so much dermatitis or exfoliation of the skin.

It is clear that the amount of damage done would depend on the variety of bacteria introduced beneath the skin, and to the resistance of the animal against the particular organism.

One remarkable fact I have noted which applies to both species of larvæ, is that the swellings and skin lesions are confined almost entirely to the older animals, the calves only show slight effects. This peculiarity can be observed in several

Lesions on outside of cow's leg.

Lesions on hindquarters; note large swelling on left leg behind the udder.

microbial diseases. It is a sort of natural immunity which breaks down as they grow older, and is all the more interesting because young cattle are more parasitized than the old by Warble flies.

No appreciable lesions have been noticed below the knee or hock. The skin while it is very thick on the legs, is quite porous and open; perhaps owing to its tightness and thickness the swellings are not so evident. *H. bovis* does not lay as many eggs round the hoof as *H. lineatum*. This is an important difference, for it is probable that many of the lamenesses resulting from swollen feet are due to the larval penetration. For three years in succession, lamenesses among the cattle have occurred here during the season for *H. lineatum*.

Situations in Which Eggs are Laid.

There is little to add to my previous descriptions, except to emphasize the irregular distribution of eggs as compared to *H. lineatum*. The photographs show the scattered lesions. The irregularity must be due to the fact that cattle

are running when the fly is laying, so that the eggs are deposited at random. On a number of occasions *H. bovis* was seen flying beside the animals just about level with the stifle joint, striking repeatedly at the outside of the leg. This is, I find, the most common manner of ovipositing during rapid flight. Another favorite way is to follow a foot or two behind, then catching up and striking just below the pin bones. But the first few strikes prior to the animals getting away are almost invariably on the legs, lower down.

Summary.

The seasonal activity of *H. bovis* at Agassiz is from the beginning of June to the beginning of August.

The last larvæ to emerge from the backs of cattle, leave during the first days of July.

In *H. bovis* the pupal period averages thirty-five days.

High temperatures shorten the pupal period.

The fear cattle have for *H. bovis* is due to the insect's persistence and manner of egg-laying.

Hewitt's observations on the penetration of the skin by the larvæ of *H. bovis* are confirmed.

The lesions caused by the larvæ, differ from those of *H. lineatum*. Older animals show more lesions than the young.

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Note.—I am indebted to Dr. F. Torrance, Veterinary Director-General, for permission to publish this article.

The President: Mr. Treherne is to be congratulated on the excellent manner in which he has presented another man's piece of work. It is very difficult to present in so intimate a manner the work which another man has been responsible for, but it shows how closely Mr. Treherne has watched and been interested in the work of Dr. Hadwen. I think it is one of the most important papers that has been discussed at this meeting. The question of the method of entrance of *Hypoderma bovis* has been a disputed point for many years and we have had observations and evidence supporting now one view and now another, but in view of Dr. Hadwen's conclusive experiments, which have been supported by photographs, I think he has cleared up this question. We are pleased to have with us this morning Dr. T. Torrance, the Veterinary Director General of the Health of Animals Branch, Department of Agriculture, and perhaps he would have something to say in connection with these two papers.

Dr. Torrance: Mr. President, ladies and gentlemen, it affords me very great pleasure to be with you to-day, especially as one of our men has contributed something towards the programme. The work which Dr. Hadwen has done is very much appreciated by his chief, and I think, will be appreciated by all when it is better known. He has proved a very diligent and careful investigator, and I think the facts which he has brought out will bear the closest scrutiny. He has succeeded in throwing light upon a very difficult problem, the problem of the migration of newly hatched warble larvæ to their final resting place beneath the skin of the back. The importance of this work will be realized when I tell you that in Canada the leather produced is damaged to the extent of perhaps 70 per cent. by the presence of this larva. After the larva has escaped from the back the scar tissue which repairs the damage causes that portion of the leather to be unsuitable for the manufacture of the better grades of harness. You are, perhaps, aware that in making harness, especially traces, it is necessary to take long strips of the thickest leather from along the back. This is the part that is chiefly damaged by the warble flies, so that the best portion of these hides is unsuitable for the manufacture of harness. In correspondence with practically all the tanners of Canada referring to the damage done by this parasite, the opinion was expressed that it was the greatest source of injury to the leather that they knew of. There were not many other things that caused the same amount of damage. The injury caused by barbed wire fences, warts, etc., was trivial when compared with the damage caused by this warble fly. It is only by the close study of the life-habits of a parasite that we can arrive at the best possible means of combating it and we hope that the result of this work of Dr. Hadwen's will be some practical method whereby the damage caused by this insect can be avoided. I was greatly interested, too, in the paper read by Professor Lochhead, in the damage he describes in horses, as we have had practical experience with the effects of these parasites on horses. The more common is the one to which he did not refer, the *Gastrophilus equi*, an extremely common parasite of horses. In my experience covering thirty years of active practice I may say that I have seldom found a horse not infested. Every horse that passes a portion of its life in the open is sure to contain these parasites. In cities horses may possibly avoid them but it is very common to find them in a horse's stomach. Among farmers the presence of bot larvæ in a horse's stomach is looked upon as the cause of the horse's death in very many cases, but when we find them in horses that have died from any cause we may realize that the presence of a moderate number of these parasites may be tolerated without injury to the animal's health. On the other hand, we know that where they are present in very large numbers they affect the function of the stomach to such an extent that many derangements may take place, such as ulceration of the walls of the organ. These larvæ are harmless when in small numbers but in large numbers cause much trouble and sometimes death. The Nose Bot Fly, which give so much trouble to the farmer in the North-west when he is hitching up his horses, does not cause so much trouble: it is not nearly so harmful to the horses and we have very few examples of its doing much injury, the annoyance it gives is about all the harm it does. Why the ovipositing of these two flies, the Bot Fly of the horse and the Bot Fly of the cow, should occasion such intense fear in the victim I do not know. We are assured by scientists that neither of these flies have any stinging apparatus and yet the animal affected shows every evidence that the fly must inflict much pain. I cannot imagine that the depositing of the eggs upon a hair would give so much discomfort to the animal. I think we will

have to search a little further, probably, and gain more experience before we learn the actual cause of the terror in cattle and horses caused by the Bot and Nose Flies. The contributions that have been made on this subject to-day are of great importance and I wish to express the feeling of pleasure that I have in meeting you all to-day and to assure you that my Branch will assist Dr. Hadwen in carrying on the work he is now engaged in.

The President: The Society is very much indebted to Dr. Torrance for his valuable contribution and for the information which he has given from the veterinary side.

Dr. Torrance: Mr. President, I have brought up with me some specimens and pictures which Dr. Hadwen sent me.

The President: The question of the effects of internal parasites which Dr. Torrance brought up is one which has been always of great interest to me, and it becoming more generally realized that the importance of these parasites is not so much because they are present but owing to the fact that their presence may be responsible for the penetration of the mucous membrane of the alimentary tract. Now these two papers have a number of important points and I have no doubt there are other members who would wish to discuss them.

Mr. Tothill: Mr. Chairman, this paper to me is one of the most interesting that has been presented for some years on account of its extremely interesting biological points and on account of its significance. It may be interesting to recall that the origin of the Oestridæ is quite uncertain, but at the same time they are undoubtedly related to the parasitic dipterous families Tachinidæ and Dexiidæ. In my studies on life-histories of the Tachinidæ some years ago it became evident that there was something the matter with the supposed life-history of the Bot Fly. In the Tachinidæ there are flies which deposit eggs which are taken into the alimentary canal. The larvæ migrate from the alimentary canal to various tissues of the host. In every known case in which this habit obtains the egg is modified for passing down the alimentary canal without injury. In the eggs of these warble flies it is evident that there is no such modification for such a habit and this work of Dr. Hadwen's clearly shows that the larvæ do not pass through the alimentary canal, is very interesting.

Mr. Sanders: In regard to the date of introduction of *Hypoderma bovis* into Canada, we have a pretty fair idea as to when it first became common in Nova Scotia owing to the fact that oxen are worked so much more down there than in the rest of Canada. Farmers will tell you that the Gad Fly became a nuisance in Nova Scotia about fifteen years ago. It causes a little damage that has not been mentioned in these papers, that is, the damage that the oxen do when they are attacked by these insects. It drives the oxen almost frantic; appearing about the 10th July and attacking the oxen all through haying time. Sometimes they will be driven so wild as to run away with the loaded hay waggons, and often will break wheels, axles, tongues or yokes in their efforts to get away from the insects. We find that cattle are mostly attacked in the open, and when a Gad Fly appears in a herd of cattle they will at once take to the bush where they seem to be free from attack. From Dr. Hadwen's work, can Mr. Treherne suggest any method of control?

Mr. Treherne: I don't think it would be letting Dr. Hadwen's secrets out if I told you that he is pretty well satisfied he can effectively control these flies. Now that the penetration takes place through the skin, he thinks he can dip every ten days or so and give the larvæ a dose of arsenic.

DR. TORRANCE: Might I be allowed to say another word in connection with the last fact brought out by Mr. Treherne. There is a portion of the North-west territories in which the disease known as Mange of cattle has been in existence for some time. This is known as the "Mange Quarantine Area," in which we require the dipping of all cattle. It has been found that in this area it has also had the effect of lessening the ravages of the warbles. The skins of the cattle in this district are more free from warbles than they are anywhere else.

DR. FERNALD: It certainly seems that the two papers here this morning have contributed much of interest to this subject. I am very glad, indeed, that I can now change a statement made to my junior students that the eggs of the warble fly are licked off into the mouth, and give something that is more accurate. I have thought for many years that there was room for more work on this subject, but certainly in the regions where I am now living these flies are not abundant enough to cause much attention and the opportunities for their study have been few. In connection with Professor Lochhead's paper, the attitude some of his correspondents have taken has been paralleled by an experience of my own. A case was recorded this fall of a house having been so infested by fleas that it was impossible to live in it. The members of the family were very anxious to know what could be done. I naturally, under the circumstances, gave out the remedy for fleas. When the specimens came in accompanied by the statement that it was unbearable to live in the house on account of the bites of these fleas, the specimens were those of the Pomace Fly.

MR. PAYNE: I understand, Mr. Treherne, that Dr. Hadwen has found in the migration of the second stage larvæ that they pass down the spinal cord, is there anything in that?

MR. TREHERNE: As far as I understand, Mr. Payne, the eggs, if laid on the knee, for instance, hatch and the larva passes up by the fibrous tissue route until it reaches the stomach, and after stopping there for some time it proceeds in a direct line to the back of the animal, emerging, however, horizontally in the last stage.

MR. PETCH: *Hypoderma bovis* in the counties of Huntingdon and Chateauguay has proven to be a very injurious insect, and as these two counties are practically a dairying district, I would like to know if Dr. Hadwen has found any appreciable effect on the milk supply.

MR. TREHERNE: The irritation produced by larvæ within the bodies of cattle does not seem to affect the milk supply to any great degree, but the presence of the fly in the pasture field and its terrifying effect, may easily be understood to affect milk yields.

THE PRESIDENT: The only damage caused, Mr. Petch, seems to be that the cattle are bothered while feeding.

PROF. LOCHHEAD: There is a suggestion in connection with one of the letters which I received and which, I think, this Society could take up, that is, the removal of the warbles before spring from the backs of the cattle. If all the farmers co-operated and removed the warbles before the first of April I think it would soon control this warble fly and, at any rate, it would be worth while trying. I would like to hear what the Society thinks of such a move.

THE PRESIDENT: As Professor Lochhead no doubt knows, that system has been followed in Europe, especially Germany and Denmark. It is customary to appoint a man to go around extracting the warbles, making a small charge per head and it certainly accomplishes much good, and I recommended in my

annual report a few years ago the importance of such co-operation. This could be helped along very much by the use of the press.

If there is no more discussion on these two papers we will pass on to the next paper on "Forest Insect Investigations in Canada." I regret to say that Mr. Swaine, who was to have read this paper, has been suffering very severely from grippe during the past week or so, and while he hopes to be at the meeting this afternoon he did not feel sufficiently well to give his address this morning, so we will postpone the paper until this afternoon. Therefore, I will take this opportunity of making a few brief remarks in regard to the progress of our work.

PROGRESS OF ENTOMOLOGY IN CANADA DURING 1915.

C. Gordon Hewitt, Dominion Entomologist, Ottawa.

As I remarked in opening our meetings yesterday I do not consider that it is necessary or even desirable for the President to give a presidential address on re-election, apart from the fact that we have a very full programme. Nevertheless, it may be of interest to review the progress of our work in Canada during the past year, especially as we have a number of visitors from other countries. As you may remember, the Minister of Agriculture arranged for a campaign to be carried out shortly after the outbreak of war for the purpose of securing greater production and in this work the Provincial Governments co-operated fully. That this campaign has proved successful is shown by the fact that the other day the Minister of Finance, in Montreal, said that on a conservative estimate our agricultural products would exceed those of last year by three hundred million dollars: such a result at the present time when the question of food supply is a vital one is very encouraging. As entomologists we have played our part in this successful effort to increase our production. Everyone realizes that increased agricultural production is dependent very frequently on the control of insect pests. One of the most important steps to be taken in order to secure production is to reduce or eliminate those factors which check or reduce production: of these factors insect pests are one of the most important. For this reason we have all endeavoured to exert ourselves harder than ever during the past year with a view to persuading the farmers and fruit growers to take steps in an increasing measure to control those factors which are responsible for loss of production.

I feel sure that those of our officers who have been working at the Branch Laboratories in the various provinces will feel that their work has been very successful in this direction. In Nova Scotia, the energetic work that has been carried on so successfully by Mr. Sanders has done more than anything else, so I am informed by the fruit growers of that province, to increase spraying and spraying along successful lines in the Annapolis Valley. This means more fruit and fruit of a better grade.

Mr. Petch has been carrying out similar educational work in Hemmingford County in Quebec, with good results, and has shown the value of insect control in the production of more fruit and fruit of a higher grade.

Our work on Locust Control in the Province of Quebec will be described by Mr. Gibson this afternoon. The depredations of locusts in certain parts of the Province of Quebec have been serious and extreme during the last few years. In some

sections farmers had to abandon their farms on account of the repeated total destruction of their crops by locusts, and the number of abandoned farms in some parishes caused serious apprehension. We have been carrying on experiments in the control of locusts by means of poisoned baits and decided to carry on the work on a larger scale during the past season. In certain parishes we were fortunate in having the co-operation of the parish priests, who were of great assistance in bringing about co-operative effort on the part of the farmers. We have been able to demonstrate to those farmers the value of poisoned baits and the change that has been wrought is most satisfactory. Serious losses year after year had disheartened these farmers to the extent in many cases of compelling them to abandon their farms as I have remarked. Now they have found the means of controlling the locusts at a comparatively low cost and of saving their crops, and the saving in the aggregate has been very great during the past season. The farmers have not only returned to their farms, but those who had remained, although disheartened, now see a brighter prospect and will improve their farms on account of the possibility of removing the cause of the depression.

Mr. Strickland described to us yesterday his work on the control of Cutworms in Alberta, and I do not think that this subject requires further discussion on my part. He described very clearly how by his investigations and demonstrations to the farmers he was able to prevent serious losses which otherwise would have occurred in Southern Alberta.

I have only mentioned a few cases. In such manner our work has been of direct assistance in the movement for increased production. Similar work has been carried out at all our field laboratories and from headquarters, and each of the Provincial Departments of Agriculture who maintain an entomological staff has been increasing the activity in their efforts.

This increased assistance has created a greater demand for such assistance and we are now finding that as the farmers and fruit-growers realize that this work has been done for their direct benefit there is an increased call for assistance. It is the creation of that demand which will enable us to carry out to a greater degree the objects we are striving to obtain, namely: to bring ourselves in touch with a larger number of people whom we are able to assist by the information we are securing. All must feel that we are making the best use of our abilities in this time of great crisis.

During the past year we have discovered several new pests in Canada. Probably the most important of these is the Pear Thrips, *Tæniothrips pyri*, which Mr. Treherne reported from the Victoria district on Vancouver Island, British Columbia. The serious nature of this pest will be realized from the fact that in California it is estimated to cause an annual loss of about ten million dollars on prunes alone. At present it appears to be confined to a very small territory near Victoria, but we fear its spread to other sections. Mr. Treherne also reported the occurrence of the Currant Bud Moth, *Eriophyes ribis*, at Duncans on Vancouver Island in British Columbia. This pest has evidently been imported from Great Britain, where it is one of the worst pests of black currants occurring there, as I know from personal experience. Every step will be taken to prevent the spread of these two new and serious fruit pests.

We referred, in our session yesterday morning, to the increased organization of entomology which had taken place in Canada and I spoke of the formation of the Entomological Society of Nova Scotia, for the organization of which great credit is due to Professor Brittain. Before the outbreak of war the Council of your Society had under consideration the improvement of the organization of

Entomological Societies throughout Canada. We hoped to develop other branches and bring together a large number of people interested in entomology who are at present unattached to any society and in turn to bring them into touch with the active workers; but as this question involves financial consideration it must necessarily be postponed. Nevertheless, the Society has every reason to be proud of the manner in which entomology is now organized throughout the Dominion and the increased attention that is being paid to this study. Throughout the country we are finding more and more people who are becoming interested in the subject and in time we will endeavor to create a sentiment which will be productive of pleasure to themselves and of value to us in our practical work.

You will be pleased to learn that increased facilities have been provided for the work of the Entomological Branch during the past year and I think it will be of interest to all the members of the Society if I describe the new laboratories that have been erected during the past year.

The pressing need for increased accommodation for the entomological work that is being carried on in various provinces by the Field Officers of the Entomological Branch, and a demand on the part of farmers and fruit-growers for further assistance in controlling insect pests, have been responsible for a decision on the part of the Minister of Agriculture, to have entomological laboratories erected where they were most necessary. Accordingly four new laboratories have been built during the past summer at the following places: Annapolis Royal, N.S.: Fredericton, N.B.: Treesbank, Man.: and Lethbridge, Alta. These laboratories I will briefly describe.

Entomological Laboratory, Annapolis Royal, N.S.

Since 1912 a small laboratory at Bridgetown, N.S., served as headquarters for the entomological work of the Branch in Nova Scotia. The increase of the work and of the staff employed necessitated increased accommodation. Annapolis Royal was selected as the place for the new laboratory on account of its situation in reference to the area of the Brown-tail Moth infestation, convenient railroad facilities and the presence of a promising fruit-growing district in which the orchards were not at present properly cared for. The laboratory is erected on an excellent site on the County School Grounds which the School Board of Annapolis Royal have kindly provided.

The building measures twenty-six feet square and consists of basement, ground floor and attic. In the roomy basement accommodation is provided for field and spraying equipment; it also contains a dark-room and laboratory. The ground floor is divided into three rooms, namely, an office for the Field Officer in charge, a large laboratory and a general work room. The commodious attic is specially well-lighted to serve as a photographic room and work room. Steam heating is installed.

From this laboratory the campaign in Nova Scotia against the Brown-tail Moth is directed. In addition, investigations are being carried out by Mr. G. E. Sanders, Field Officer in charge, on the more important insects affecting fruit* such as the bud-moth and fruit-worms of apples. Experimental work in spraying and the investigation of insecticides has already rendered very valuable assistance to the fruit-growers of the province. The former entomological station at Bridgetown will be used as a sub-station whenever it may be most needed.

*To prevent duplication of work and to secure the best co-operation, the Dominion Field Officer confines his attention to the biting insects and the Provincial Entomologist, Prof. Brittain, studies the sucking insects (aphides and bugs).

Entomological Laboratory at Fredericton, N.B.

In 1912, a small laboratory was established at Fredericton, N.B., in connection with the Brown-tail Moth and other work in New Brunswick. The University of New Brunswick provided a site on the University campus. The increase in the infested area, and the large amount of work consequent upon our efforts to establish the parasites of the Gipsy and Brown-tail Moths imported from the New England States and the carrying on of an extensive study of the natural control of certain native insects such as the Tent Caterpillars, the Spruce Bud-worm and Fall Web-worm, rendered an increase in the laboratory accommodation immediately necessary; the University had kindly permitted us to use one of their large laboratories during the summer.

The building is of solid brick construction and measures twenty-four feet by thirty feet. It consists of basement, ground floor, first floor and attic. The basement contains the water supply for the building, comprising a well, tank, and electrically driven pump, and provides storage room for field equipment and supplies. The ground floor contains at the front offices for the two officers in charge of the work; Mr. J. D. Tothill has charge of the colonization and study of the parasitic insects and Mr. L. S. McLaine has charge of the field work against the Brown-tail Moth and the collection of parasites in the New England States; at the back is a work room. On the first floor a large laboratory occupies the front half of the building and behind a specially lighted room is provided for photographic and other work; a dark room and bath room are also provided on this floor. The high pitched roof furnishes a roomy attic for storage purposes. Steam-heating and electric light have been installed. The building is well situated on the University campus on a site which the University authorities have generously provided.

The work that is carried on at this laboratory comprises some of the most important investigations that the Branch is prosecuting on the natural control of insect pests. The thoroughness with which the Brown-tail Moth campaign is carried on is evidenced by the fact that by taking the necessary measures from the time of the discovery of the first infestation, it has been possible in New Brunswick to prevent this insect from becoming established in the Province; whereas it is established in Nova Scotia owing to a lapse of some time before the infestation was discovered in 1907 and eradicative measures were begun.

The small laboratory will be used as a sub-station in another part of the Province.

Entomological Laboratory at Treesbank, Man.

Mr. Norman Criddle was appointed in 1913 to carry on investigations on White Grubs (*Lachnosterna*) and other cereal pests in Manitoba and adjoining territory. As the temporary quarters he occupied did not afford adequate accommodation for his work a small wooden laboratory measuring twelve feet by sixteen feet has been erected during the past summer on a site kindly provided by Mr. Percy Criddle on his farm where excellent facilities occur for field and experimental work.

Entomological Laboratory at Lethbridge, Alta.

Investigations on insect and other pests in Southern Alberta were commenced in 1913 by Mr. E. H. Strickland, Field Officer for Alberta, who was provided

with temporary laboratory accommodation at the Dominion Experimental Farm at Lethbridge, Alta. During the past summer a permanent laboratory was built on the Experimental Farm.

The building measures twenty-three feet by twenty feet and contains four rooms, namely: office, laboratory, spare room and dark room. By arrangement the Director of the Experimental Farms and the Superintendent of the Farm have kindly furnished for experimental purposes a small plot of ground adjoining the laboratory.

I will not take up more of your time with any rambling remarks of mine; but before closing I should like again to express to our visitors our gratitude to them for coming so far to take part in our proceedings, their presence and contributions to the programme and the discussions are a source of great encouragement to us and I think they will admit that though our numbers are not large the character of the work that has been described is of the highest nature judged by any standard, and that our enthusiasm could not be excelled.

THE LIFE HISTORY OF *CHERMES COOLEYI* GILLETTE IN STANLEY PARK, VANCOUVER, B.C.

R. N. Chrystal, Field Officer for Forest Insects, Entomological Branch, Department of Agriculture, Ottawa.

As a result of an enquiry into the serious injury done to the Sitka Spruce in Stanley Park, Vancouver, B.C., by the attacks of the above species of gall-making insects of the Genus Chermes, the following notes of its life history and habits in that region are presented. This species was named and described by Professor Gillette, Fort Collins, Colorado, in his paper, "Chermes of Colorado Conifers," Proc. Acad. Nat. Sci. Philadelphia, Jan., 1907; its life cycle also being discussed. The following account in a large measure confirms the results given in the above paper, differing only in the species of spruce attacked, and some minor details.

The hibernating stem mother on the Spruce, is oval in outline, flat, .5 to .7 mm. in length, .3 mm. in width, dark brown to black in colour, with a slight fringe of white waxy threads along the edges of the body, and down the middle of the back. The body of the louse is closely appressed to the twig, and the setæ are deeply sunk in the crevices of the bark. The location on the twig varies, from immediately below the terminal bud to 3 inches down the stem.

During the first week of April, 1915, the stem mothers, having cast their winter coat, began oviposition on the spruce, the waxy secretion increasing to such an extent by this time, as to hide the dark coloured, and now much swollen body of the insect from view. Several hundred eggs may be laid by this Chermes, as many as 500 being counted in one egg mass; in cases where several stem mothers are located in close proximity to each other on the twig, the egg masses come together, and the waxy secretion becomes very conspicuous. The eggs are light brown in colour, lightly dusted with a whitish powder, each attached to the stem by a fine thread. They hatch in about 5 or 6 days, and the young, which are light reddish in colour, locate themselves at the inner bases of the young needles, then just breaking from the bud scales. A gall begins to form, and develops with great rapidity, the complete formation taking only a few days in some cases.

THE GALLS: The galls vary in length from ½ inch to 3 inches, the size apparently depending on the strength of the twig attacked. The following conditions may prevail:

(*a*) The whole twig may be completely galled.

(*b*) The twig may be galled on one side only, causing twisting and bending of the stem.

(*c*) Rarely, the upper part of the twig may be galled all round, and the lower part only half way round.

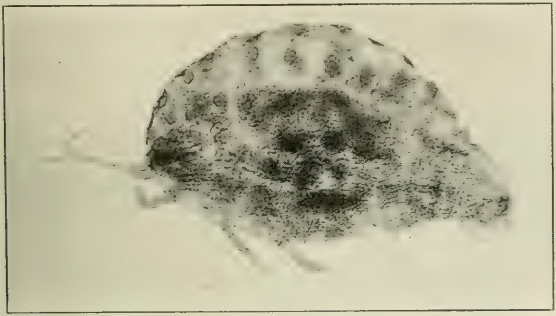
In Stanley Park the first condition was by far the most common, but it may be said, that even in cases where the twig was not completely galled, its ultimate destruction through weakness was, in nearly every case, assured. The number of

A Sitka spruce killed by chermes galls.

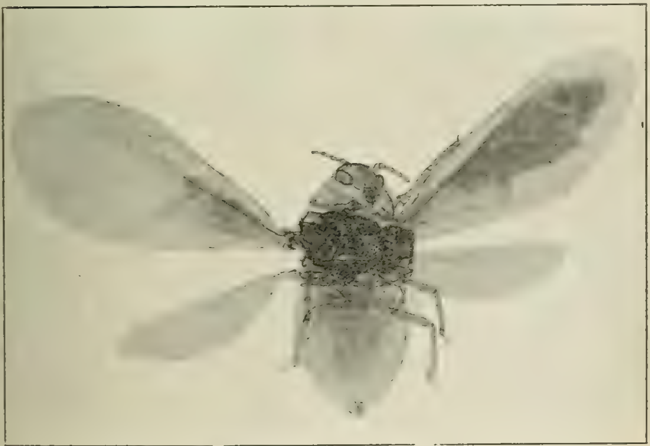
chambers varies from 40 to 200, the number of young in each chamber varying from 1 to 15, with an average of 5. The young are seen to be covered with a waxy coat, which, as Professor Gillette indicates, provides them with a very efficient protection against the superabundance of liquid excretion which they exude. If galls, which are nearly mature, be opened, cast skins of the young may be found filled with this liquid. These very remarkable objects are also mentioned by Professor Gillette in this connection. A few days before the galls begin to open the young inside change to pupæ, the rudiments of wings being readily seen. The earliest date recorded for the opening of the galls in Stanley Park during the summer of 1915, was June 25th. This is the earliest record for this locality so

far, and doubtless a direct result of the unusual earliness of the past season, the previous year's (1914) date being about two weeks later.

When about to moult for the last time the pupæ crawl out of the gall chambers, and settle on a needle, the head facing the point of the needle. The pupa is reddish in colour with an outer coat of wax. This outer covering begins to split from the head down the middle of the back, the complete operation of moulting lasting some ten minutes. When the moult is completed the cast skin, a ghostly replica of its former occupant, is left hanging to the needle.



Details of wax glands, var. *coweni.*



Winged migrant to Douglas fir.

The newly emerged winged form has the antennæ and legs very light yellow, almost transparent; the eyes dark red and very conspicuous, the head, prothorax and abdomen rufous red, the mesothorax yellowish, streaked with red. The wings are crumpled up at first and dark green in colour, with the exception of the costal nerve, which is yellow. The green colour remains for some time after the wings are finally resting roofwise over the back of the insect.

The waxy excretion does not make its appearance in any quantity until some twenty-four hours after the winged form has emerged from its pupal covering.

Migration. Experiments were carried out in Stanley Park two years ago with the object of confirming the former observations on the secondary host tree. Opening galls were placed in cages along with fresh branches of Sitka Spruce

Stem mother on Sitka spruce.

Experimental cage in Stanley Park.

(*P. sitchensis*), Douglas Fir (*Pseudotsuga mucronata*) and Western Hemlock (*Tsuga heterophylla*), these three trees being the only conifers within the precincts of the Park. The experiments showed beyond all doubt that the secondary host tree was the Douglas Fir; only a few lice locating on the spruce and hemlock, on which they apparently do not thrive; whereas they were found settling freely on the needles of the fir, as many as 7 being found on the same needle, 2 or 3 being a common number. A few figures of the cage experiments are given below:

	Nos. of Lice Settling on Each Tree.		
Cage.	Spruce.	Douglas Fir.	Hemlock.
1	0	221	0
2	1	672	5
3	15	216	0
4	0	275	2

No success attended the attempts to breed the specimens through on spruce and hemlock at this time. In the open, winged migrants were found locating on the Douglas fir, confirming the experimental results, but in no case was any winged migrant found on a spruce or hemlock in the open. Within a very short time of settling on the needle of the Douglas fir the winged migrant commences to oviposit, about 100-150 eggs being laid. These hatch in 6 to 7 days, and the young, which are elongate oval in shape, and almost black in colour, with only a trace of wax present, settle on the needles of the Douglas fir. There they remain motionless, without any apparent increase in size, through the rest of the summer, fall and winter of the year, until the following spring; when having moulted once, they commence oviposition as stem mothers on the needles of the Douglas fir, laying from 30 to 40 eggs, which hatch in numbers about the end of May and the beginning of June.

This life cycle was traced out for Stanley Park by observations on marked twigs of Douglas fir, through the summer, fall and winter of 1914-15. During

Stem mother on the Douglas fir.

the first half of May, 1915, this generation on the Douglas fir was observed to be dimorphic, about 50 per cent. of the lice developing wings and migrating back on to the Sitka spruce, while the rest remained like the parent on the fir.

The migration back to the Sitka spruce began about June 6. Experiments were started in this case as well as in the case of the former migration to the fir, to endeavour to determine for certain that the Sitka spruce was the return host. Young trees, of the three coniferous species, spruce, Douglas fir, and hemlock, were used, being enclosed in a cheesecloth cage. The fir was heavily infested with the Chermes and gave promise of good results. The numbers of migrants located was disappointing, but gave clear indications that the Sitka spruce was the chosen tree, the migrants found settling on the Sitka spruce in the cages were compared with winged migrants found settling on the spruce in the open and proved identical.

This form on the fir is Professor Gillette's *Chermes cooleyi* var. *coweni*. The apterous forms left behind on the needles of the fir, increase in size, and amount of wax secreted; lay a small number (30-40) of eggs, and the young on hatching take up their location on the needles of the spruce, there to remain until the following spring when they become stem mothers. The winged migrant to the spruce lays 30-40 eggs, and then dies, the eggs hatch in about a week and the young, which

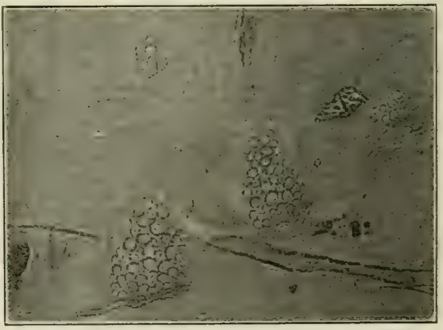
were kept under observation until the winter, remain on the needles, and probably, although this fact has not yet been actually followed in the case of Stanley Park, remain stationary until the following spring, when they become stem mothers for the new broods on the Sitka spruce.

Full descriptions of the various forms of this species and its variety *coweni* have already been published by Professor Gillette in the paper already cited; the writer would like to take this opportunity of acknowledging the assistance rendered by Professor Gillette in the identification of the material submitted to him.

A careful study has been made of the various forms, using Professor Gillette's published descriptions, and these have agreed in every case.

Mention may be made here of the principal differences between the various corresponding stages of the two forms on the fir and the spruce.

Chermes cooleyi Gillette.	*Chermes cooleyi* var. *coweni* Gillette.
Winged Migrant to Douglas Fir.	*Winged Migrant to Sitka Spruce.*
Antennal joints slender.	Antennal joints robust.
Antennal sensoria larger.	Antennal sensoria smaller.
Pores of wax glands small.	Pores of wax glands large.
Stem Mother on Spruce.	*Stem Mother on Douglas Fir.*
Wax glands large, with small pores.	Wax glands small, with large pores.
Beak long and slender.	Beak short and stout.



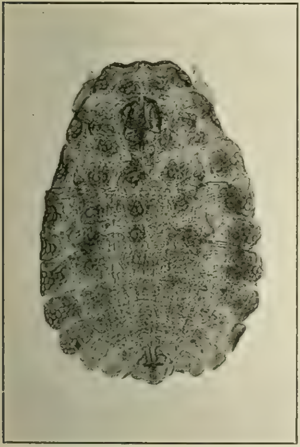
Winged migrant to spruce; details of wax glands.

Damage to the Spruce. The damage done to the Sitka spruce in Stanley Park by this form has been very considerable, a large number of trees have been killed, whilst many others are in a dying condition and beyond hope of recovery. The fact that in most cases the whole of the young twig is destroyed makes the injury very much more serious.

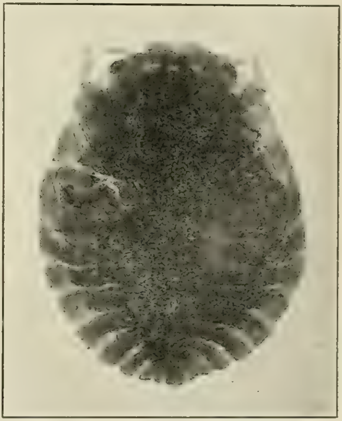
The Douglas Fir. The damage done by the form *coweni* on the Douglas fir has never been particularly noticeable, no deleterious effect on the health of the fir in the Park having been noticed. Only in one case outside Stanley Park, in a garden where a Douglas fir and Sitka spruce were growing alongside each other, the spruce being very heavily galled, did the needles of the fir show effects of heavy infestation later on in the summer. The nature of the damage on the fir is to cause the needles to curl and bend at the points of attack.

NATURAL ENEMIES. Syrphus fly larvæ and coccinellid larvæ have been observed feeding upon the pupæ in the galls, but not in sufficiently large numbers to produce any appreciable effects.

THE PRESIDENT: We are very pleased to have this account of Mr. Chrystal's work from himself for the benefit of those who are here and who may know when I say that Stanley Park, in which Mr Chrystal is working, is one of our finest pieces of natural woodland in the whole Dominion, and is known to all foresters in Canada; but unfortunately, owing chiefly to the depredations of certain species of insects, its beauty is fast passing away. When I visited the Park last summer I was abhorred to find the enormous destruction which has been caused in a few years by various species upon which Mr. Chrystal has been working. They really are the reason of Mr. Chrystal's presence in Stanley Park. There are whole areas



Stem mother from Douglas fir.



Stem mother, from spruce.

of hemlock there which are absolutely dead, places which Mr. Chrystal has named "the graveyard." I had with me Mr. James White, the Assistant Chairman of the Commission of Conservation, and we were able to demonstrate to him the enormous destruction of these trees by insect pests. I fear the time has nearly come when Stanley Park may no longer be considered Canada's most beautiful natural park. This paper is now open for discussion and perhaps Mr. Macoun, the Dominion Horticulturist, who is with us this morning, might have some remarks to make in regard to this paper.

MR. MACOUN: I am afraid I have not much to add to what you have said, Dr. Hewitt. Stanley Park is one of the sights of Canada and certainly everything possible should be done to preserve it.

PROF. CAESAR: I would like to ask if this species is native to North America and also whether Mr. Chrystal has yet in mind any plan of a practical means of control.

MR. CHRYSTAL: Prof. Gillette states in his paper that on seeing the species of *cooleyi* he described it as a new species and said that this species was confined to the Rocky Mountain region. The state of the spruce in the Park was very bad; on careful examination about 60 per cent. were found to be beyond hope of control, but the rest could be sprayed, even to a considerable height.

PROF. CAESAR: It is quite an interesting matter of observation at Guelph to note that *Chermes abietis* and *Chermes similis* have, the last few years, been almost totally controlled by some natural enemy. Since this western species is a native insect one would expect that sooner or later we should have natural means of control of it too.

MR. TOTHILL: There has been an outbreak of presumably *Chermes* in New Brunswick. This outbreak was exceedingly conspicuous about three years ago and Professor Caesar will know fully well, the outbreak has been brought under complete control.

THE PRESIDENT: If there is no further discussion on this paper we will pass on to the next and last of this session. There are really two papers but they will be taken as one and read consecutively.

THE CABBAGE MAGGOT—AUTUMN DEVELOPMENT IN BRITISH COLUMBIA.

(*Phorbia brassicæ.*)

R. C. TREHERNE, FIELD OFFICER, DOMINION ENTOMOLOGICAL LABORATORY, AGASSIZ, B.C.

The matter of autumn development in the life-history of the Cabbage Maggot is obviously of great importance in the control of this fly. On the basis of the knowledge obtainable in the autumn rests the question of autumn cultivation and the destruction of the refuse and debris resultant from the summer's crop. Still further great bearing will be obtained on the early spring development, inasmuch as little change is undergone by the spring by these forms entering upon the winter.

I do not propose, at this moment, to present all the information that has been obtained during the past few years in British Columbia on the life history and characteristics of this important pest, but merely to confine myself, in the time allotted, to a consideration of the developments that occur in the autumn.

Inasmuch as climate may offer changes and locality present differences, I shall confine myself strictly to conditions that prevail at Agassiz, B.C. (Lat. 49.15, Long. 121.40, 52 feet above sea level), which in themselves are comparable to the entire Lower Fraser Valley or what is known as the "Lower Mainland" of the Province.

It is my belief that opinions generally consider that the Cabbage Maggot Fly passes the dormant winter season mainly in the pupal state in the soil surrounding cruciferous roots or imbedded in the root itself. There are also opinions expressed from various quarters that there is a "possibility" that the fly may pass the winter in the adult condition. It is not my intention to enlarge on these expressions, but inasmuch as it is our duty to take careful observations in each locality where this fly is a pest and the growing of vegetable crops is a leading industry, I merely wish to offer a contribution on the life characteristics of the fly in the locality above mentioned.

Further I may say that up to the present we have little information in this Province on the habits of this fly and little knowledge, other than the generally accepted conceptions, on which to base the more approved remedial measures.

Without entering upon a detailed study of the complete life history of the fly, I wish to say that usually there are three complete and overlapping generations of this fly at Agassiz. It is possible for forms of the third generation to appear on the plants as early as July 18th, developing from the first eggs of each generation, while the second generation would ordinarily cease approximately about September 1st.

I will commence the discussion on the autumn development of this fly from this date, September 1st, and, in doing so, consequently, we will be dealing in all probability with third generation forms with a possibility that certain of the younger stages may belong to the fourth generation.

Autumn Fly Emergence.

Cabbages and cauliflowers are harvested mainly in the months of August and September. During the past three years larvæ have been observed at times during each of the months of October, November and December working on roots of cruciferous plants. This year particularly an attempt was made to account for these larvæ and to solve the question of the hibernating form.

In the process of harvesting, therefore, collection was made of all pupæ seen and these were placed under observation in a sheltered place, but under supposedly equal atmospheric conditions as would prevail in the open field. One was struck during the course of the field observations with the preponderance of pupal forms over the larval, and one might easily suppose that given a cold wet autumn with low maximum and minimum temperatures that pupal forms would continue as such for the winter and larvæ would complete their growth and pass the winter as pupæ also. Detailed observations in an autumn of such a nature are lacking up till the present. As it happened, the past two years, 1914, 1915, when the notes herein presented were recorded, have been open and mild, during September and October. Such a condition is not out of the ordinary in this part of the world, thus the facts recorded are of interest.

From puparia collected, therefore, the following emergence of flies is recorded. It will be seen that the number of puparia under observation is increased on certain days. This is explained by the fact that harvesting operations were continuing and more pupæ were being collected and added to the number under observation.

TABLE 1.—Autumn Fly Emergence.

Date	Number pupæ under observation.	Number of flies emerging.	Sex. Male.	Female.	%
September 1st.........	137	1	1	....	.8
" 2nd	136	2	1	1	1.5
" 3rd	134	3	1	2	2.2
" 4th	131	0	....	....	0
" 5th	131	8	6	2	6.1
" 6th	123	0	....	....	0
" 7th	123	1	1	....	.8
" 8th	122	2	1	1	1.6
" 9th	120	1	1	....	.8
" 10th	119	7	5	2	5.8
" 11th	112	11	2	9	9.8
" 12th	101	0	....	....	0
" 13th	101	8	3	5	7.9
" 14th	93	5	1	4	5.3
" 15th	90 (2)	4	1	3	4.4
" 16th	96 (10)	6	4	2	6.2
" 17th	102 (12)	4	4	....	3.9
" 18th	108 (10)	2	1	1	1.8
" 19th	111 (5)	0	....	....	0
" 20th	111	9	3	6	8.1
" 21st	105 (3)	0	....	....	0
" 22nd	105	4	....	4	3.7
" 23rd	113 (12)	2	....	2	1.7
" 24th	117 (6)	5	3	2	4.2
" 25th	117 (5)	3	1	2	2.6
" 26th	114	5	3	2	4.2
" 27th	109	1	....	1	.9
" 28th	121 (12)	0	....	....	0
" 29th	121	0	....	....	0
" 30th	193 (72)	0	....	....	0

Fly Emergence in the Field.

Inasmuch as the records given in Table 1 might have been influenced by unnatural conditions resulting from laboratory arrangements, the important point was to determine whether or not the same conditions were occurring in the field under strictly natural conditions. It was clearly proved that flies will emerge from September puparia under laboratory conditions, and, as will be seen later, eggs were being taken freely in the field. Hence it was probable that flies were emerging freely from the soil in the field. In order to determine this point careful examination of the roots of old cabbage plants was made. The roots were cut and the soil worked over to the depth of 6 inches. This was done on September 28th, 29th, 30th, and it was found that out of 78 plants examined, 48 plants were or had been infested. 30 plants did not show any sign of attack, and no puparia were taken. From the 48 plants, however, were found:

124 empty puparium cases from which flies had emerged.
96 sound and apparently healthy puparia.
14 large maggots more than 3 mm. long.
4 small maggots less than 3 mm. long.

Close examination for minute forms was not made, the important point being indicated that many flies were emerging in the field. It is hardly fair to claim a ratio between the empty puparium cases taken in the field with those under observation in the laboratory, because we could not be sure when the flies did emerge. However, the fresh nature of the puparium cases leaves no room for doubt that flies emerge freely from the soil during September.

Hence it is probable that Table 1 closely approximates the actual field conditions.

Adult Fly Mortality.

Having satisfied ourselves that many flies emerge from the soil in September, several important considerations open up, viz., length of life of the fly, mortality, whether copulation occurs in autumn and eggs are laid, whether these eggs are fertile, and if so what happens to the young maggots, and lastly what proportion, if any, of the adults winter as adults.

The question of the length of life of the fly and the mortality is represented by the following table 2. The flies as they emerged, as indicated in table 1, were placed in 6-inch tubes and kept under observation in a shaded box under outside temperature conditions. Periodically they were examined for mortality and the live ones fed a little syrup and water solution. This table 2, therefore, has direct reference to the "sex" column on fly emergence as indicated in table 1. To interpret this table read horizontally for fly emergence and perpendicularly for date of death.

TABLE II.—Male Mortality.

Date.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
September 1.....	1																			
" 2.....		1																		
" 3.....			1																	
" 4.....				0																
" 5.....					6															
" 6.....						0														
" 7.....							1													
" 8.....								1												
" 9.....									1											
" 10.....										5										
" 11.....											2									
" 12.....												6								
" 13.....		x			5x			x					3							
" 14.....			x		x									1						
" 15.....															1					
" 16.....																4				
" 17.....																	4			
" 18.....										x								1		
" 19.....																			0	
" 20.....	x						x			x			2x	x						3
" 21.....																				
" 22.....									x							x				
" 23.....																				
" 24.....																				
" 25.....										x			x		x	2x				
" 26.....																				
" 27.....											x									
" 28.....																x	x			
" 29.....										x										
" 30.....																	3x	x		2x
October 1.....																				x
" 2.....																				
" 3.....																				
" 4.....										x		(1 fly escaped)								

FEMALE MORTALITY.

Date.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
September 1.....	0																			
" 2.....		1																		
" 3.....			2																	
" 4.....				0																
" 5.....					2															
" 6.....						0														
" 7.....							0													
" 8.....								1												
" 9.....									0											
" 10.....										2										
" 11.....											9									
" 12.....												0								
" 13.....					2x								5							
" 14.....														4						
" 15.....															3					
" 16.....																2				
" 17.....																	0			
" 18.....																		1		
" 19.....																			0	
" 20.....		x	x								2x		2x	x						6
" 21.....																				
" 22.....											2x			x						
" 23.....																				
" 24.....																				
" 25.....			x								x		x	x	3x	x				
" 26.....																				
" 27.....											2x									
" 28.....								x		x	x									
" 29.....													x							
" 30.....													x					x		2x
October 1.....														x						
" 2.....																x				3x
" 3.....					escaped															x

From these records it will be seen that the length of life varies from 7-25 days in the autumn. This is of interest as the average life of an adult during the summer is approximately only 4.5 days.

It will be seen that all the flies in the above table 2, which emerged from puparia up till September 20th, died.

Those flies that emerged after September 20th (table 1 indicating that emergence continued until September 27th), were treated in a different manner. It was felt that 6-inch tubes hardly gave a fair test of longevity, hence a large wire mesh cage was arranged to give the flies more liberty of flight. The records follow on this experiment.

Hibernation of the Adult.

As has just been seen a certain number of the flies that emerge as adults in the autumn live as long as twenty-five days, this period being passed in a six-inch vial. It was thought possible that the stage might be prolonged still more if the flies were allowed more room for flight and if this occurred we might persuade some of the flies to pass the winter in the adult condition. Accordingly a large cage was arranged consisting of wire mesh and suspended within was a large piece of rough fir bark, with many crevices into which flies might crawl should they desire to. This cage was suspended to the outside wall of the building. A small amount of sweetened water was placed on the floor of the cage, upon which, later, it was observed, the flies fed readily. No cabbage plant was introduced into the cage for fear the flies would be tempted to deposit eggs, and if they did so, their life functions would be over and they would probably die. Into this cage twenty-two flies of both sexes were liberated between September 22nd and 27th. Examination of the cage was difficult for fear of allowing the flies to escape. However, flies were observed dead on the floor of the cage on September 25th and finally on October 8th all the flies had died. On October 5th only six flies were observed dead on the floor of the cage, hence a rapid mortality must have occurred between the 6th and the 7th. The night of the 7th was the coldest night thus far experienced during the autumn, being 33 degrees F. This temperature may have killed the adults. At any rate we have nothing to offer which proves that flies winter over as adults although indications that such might occur were propitious. It might be noted again that no flies emerged from puparia after September 27th, despite the fact that 193 puparia were still confined on soil in boxes on that date.

I can only say that the number of flies experimented with in this instance was far too small to record an invariable and established fact I can merely say that those flies used did not survive the first touch of cold weather and hence did not pass the winter as adults. It might, however, be said with reason that it is highly probable that a small percentage of adults will winter as adults in a favorable season, although such has not been shown in our experiments thus far.

Egg Deposition in Field.

Not only do adult flies emerge freely from the puparia during September and probably part of October, but we find also that eggs are deposited equally freely during these months. These notes, recorded now, are a part of a long series of notes obtained throughout the summer on the question of egg deposition hence I shall not give the full details at this juncture. We are only interested now in the autumn development. To obtain this record 12 cabbages and 6 cauliflowers were examined daily between 4 p.m. and 6 p.m. and all eggs laid during the twenty-four hours removed by means of a knife blade and counted. By this method we would obtain an absolutely accurate record of the daily deposition. Further useful information may be deduced in reference to effects of temperature, sunshine, rain, wind, on egg deposition and the size and shape of the plant chosen for deposition.

The record follows in table 3. (For the sake of comparison the record of 12 cabbages is reduced to read for 6.)

TABLE III.—EGG DEPOSITION RECORD.

September.	No. of eggs on 6 cabbages.	No. eggs on 6 cauliflowers	Weather Notes.
1st	10	42	Morning, cloudy .... Afternoon, showers.
2nd	16.5	96	" fine .... " cloudy.
3rd	1	73	" fine .... " cloudy.
4th	15	116	" fine .... " fine.
5th	1	13	" foggy .... " dull.
6th	2.5	25	" cloudy .... " showers.
7th	3	24	" dull .... " showers.
8th	0	1	" rain .... " heavy rain.
9th	2.5	11	" fine .... " heavy rain and some sunshine.
10th	0	66	" fine and strong wind .... " fine.
11th	1	17	" fine .... " fine.
12th	7	15	Bright and sunny all day, night wet.
13th	0	0	All day cold and stormy.
14th	0	0	Warmer, but cool and cloudy.
15th	(no record taken)		
16th	0	10	Day fine, warm and sunny.
17th	0	49	Day fine, warm and sunny.
18th	0	21	Day fine, warm and sunny.
19th	0	32	Day fine, warm and sunny.
20th	9	61	Day fine, warm and sunny.
21st	10	38	Day fine, but smoky.
22nd	0	78	Day fine, warm, but dull.
23rd	(no record taken)		Showers fell throughout day.
24th	8	147	Day fine, warm and sunny.
25th	0	137	Day fine, warm and sunny.
26th	0	18	Day dull, but fairly warm; rain fell during the night.
27th	3	17	Morning dull; afternoon fair.
28th	6	80	Day fine and fairly warm.
29th	0	102	Day fine and warm.
30th	0	22	Morning dull, afternoon rain fell.
October.			
1st	(no record taken)		
2nd	(no record taken)		
3rd	0	99 (33 eggs per day)	Day dull with some rain.
4th	No further	35	Day dull with slight sun, rain at night.
5th	records	15	Morning, fine; afternoon, bright and sunny.
6th	taken on	100	Windy, but fine and sunny.
7th	the cab-	5	Day fine, warm, sunny; night coldest yet, 33° F.
8th	bages	86	Morning sunny, afternoon dull and cloudy, night warm.
9th		1	Fine all day and sunny.
10th		48	Day fine and sunny.
11th		0	Rained.
12th		0	Rained.
13th		0	Heavy rain.
14th		13	Fine autumn day, cool but sunny.
15th		11	Fine autumn day, sunny, cool at night.
16th		11	Day fine, comparatively warm.
17th		0	Day mild but no sun.
18th	(no record taken)		
19th	(no record taken)		
20th		0	Dull and wet on past three days.
21st	(no record taken)		
22nd		4	Dull but mostly fine, rain in evening.
23rd		0	Rain.
24th		0	Showery.
25th		0	Dull with showers.

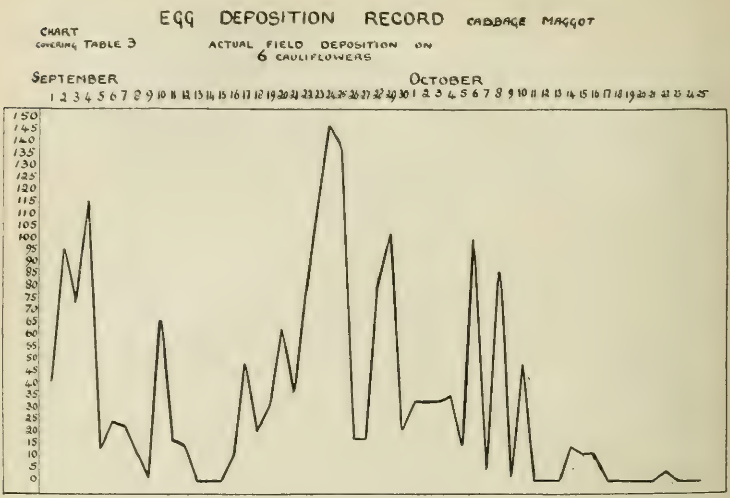
From this table 3, we find that flies were active up till as late as October 22nd; having since September 1st deposited 1,739 eggs on six cauliflower plants. The egg deposition on six cabbages for the month of September was 95.5, while the deposition on a like number of cauliflowers over the same period was 1,311. This indicates the importance of pursuing the life history on more kinds of plants than one. The records from cabbages alone would incline towards an entirely different rendering of the actual situation.

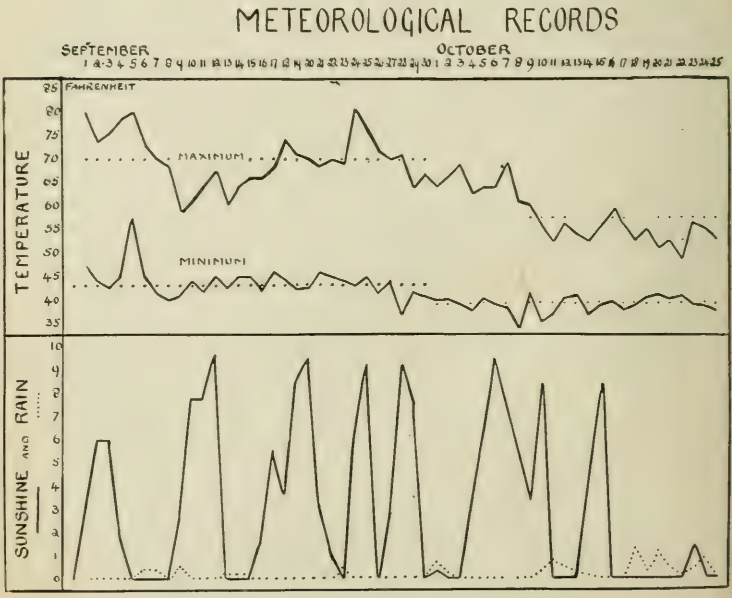
(See chart covering egg deposition on six cauliflowers.)

Autumn Larval Notes.

We are now satisfied, in the first place, that flies freely emerge from the soil in September, and in the second place that quantities of eggs are laid around plants until late into October. The high egg fertility percentage is maintained throughout the entire year, consequently we are justified in assuming that larval forms may be found working on the roots of plants during November and December. This assumption is supported by fact inasmuch as larvæ, freshly hatched, from late September eggs, having been placed on plants in pots, developed to 2 mm., 3 mm., and 4 mm. in length by the commencement of November. Inasmuch as these pots were sunk in the soil out of doors, we claim with assurance that the conditions were precisely natural.

Eggs taken from plants in the field between September 13th-26th, were hatched in the laboratory and placed on the soil around a potted plant (which was in turn sunk in the open soil), developed maggots 3 mm.-4 mm. long by October 25th. Larvæ hatching after September 26th and before 30th, treated in the same way developed maggots 2 mm. long by the close of October. There is no question of doubt that the larvæ found in both these instances would mature, pupate and pass the winter. It is true that no further notes were taken on them after this date, but their general thrifty appearance does not allow of much doubt that they will survive. Eggs hatching in October were also placed around the stems of plants and they developed slowly during the early days of November. Frost, it would seem, might affect them, especially the very small larvæ. Given no severe weather in November and December, there is, again, little doubt that October eggs will persevere also to puparia by the approach of winter. Real winter weather seldom sets in with any degree of permanence in this locality until the New Year.


EGG DEPOSITION RECORD CABBAGE MAGGOT
CHART
COVERING TABLE 3
ACTUAL FIELD DEPOSITION ON
6 CAULIFLOWERS
SEPTEMBER
OCTOBER


METEOROLOGICAL RECORDS
SEPTEMBER
OCTOBER
FAHRENHEIT
TEMPERATURE
MAXIMUM
MINIMUM
SUNSHINE AND RAIN

The Meteorological Records.

The Meteorological records covering the notes given in this paper are as follows:—

	Temperature Degrees Fahr.		Sunshine in hours	Rain in inches
	Maximum	Minimum		
September 1st	80	47	....	....
" 2nd	74	44	6.2	....
" 3rd	76	43	6.4	....
" 4th	78	45	1.8	....
" 5th	80	58	....	....
" 6th	73	45	....	.04
" 7th	70	42	....	.03
" 8th	68	40	....	....
" 9th	59	41	2.5	.45
" 10th	61	44	7.8	....
" 11th	64	42	7.8	....
" 12th	67	45	9.7	....
" 13th	61	43	....	.08
" 14th	64	45	....	.05
" 15th	66	45	....	.14
" 16th	66	42	1.5	....
" 17th	68	46	5.5	....
" 18th	74	44	3.6	....
" 19th	71	43	8.5	....
" 20th	70	43	9.5	....
" 21st	68	46	3.1	....
" 22nd	70	45	1.0	....
" 23rd	69	44	....	.48
" 24th	81	43	5.9	....
" 25th	76	45	9.2	....
" 26th	72	42	....	....
" 27th	70	44	2.9	....
" 28th	71	37	9.2	....
" 29th	64	42	7.5	....
" 30th	67	41	....	....
October 1st	64	40	.48	.61
" 2nd	67	40	....	.12
" 3rd	68	39	....	....
" 4th	63	37	3.24	....
" 5th	64	40	6.24	....
" 6th	64	39	9.6	....
" 7th	68	38	7.18	....
" 8th	61	33	5.18	....
" 9th	60	43	3.42	....
" 10th	56	35	8.48	.12
" 11th	53	37	....	.63
" 12th	56	40	....	.57
" 13th	54	41	....	.49
" 14th	53	37	4.50	.12
" 15th	55	38	8.48	....
" 16th	58	39	....	....
" 17th	56	37	....	....
" 18th	53	38	....	1.22
" 19th	55	40	....	.39
" 20th	51	41	....	1.19
" 21st	53	40	....	.52
" 22nd	48	41	....	.15
" 23rd	54	38	1.42	.36
" 24th	55	38	....	.95

THE CABBAGE MAGGOT IN BRITISH COLUMBIA (*Phorbia brassicæ*).

THE NATURAL CONTROL BY PARASITES AND PREDACIOUS INSECTS.

R. C. TREHERNE, FIELD OFFICER, DOMINION ENTOMOLOGICAL LABORATORY, AGASSIZ, B. C.

The Cabbage Maggot fly is a very serious pest in the Lower Fraser Valley of British Columbia. Variations in prevalence occur one year with another, and certain locality differences are observed in any given season. These changes are not accounted for with any degree of satisfaction, but it is certain that autumn temperatures and precipitation play an important part in the conditions that arise the following spring.

The importance of this insect may be gauged by its long period of activity. Eggs may be frequently observed deposited on the stems of plants during the first week of April, and oviposition may continue intermittently but continuously until well in October. Nearly full-grown larvæ have been taken from roots in the closing days of April, and they may be found at all times until November and sometimes as late as December. These records were taken in the Lower Fraser Valley of British Columbia and apply only to that district, which ranges about 100 miles east of Vancouver. They are, further, notes gathered from three years' work with the fly, and are only given in this connection to indicate the serious possibilities that may follow an attack by the pest.

During the past summer an attempt was made to estimate the egg-laying proclivities of the fly. A number of plants, as indicated below, were examined every day, at the same time, from April 17th until October 26th. At each examination all eggs were removed and counted, so that as a result we find we have an accurate record of the total number of eggs laid per day throughout the summer. As an indication of the seasonal prevalence during the past summer, I may say that in a large experiment on control measures, out of 215 cabbages, untreated and used as checks, only 26 died strictly by reason of maggot attack (12.1 per cent.), and out of 210 cauliflowers, of the same nature, only 24 died (11.4 per cent.). Of course many plants were attacked and a diminution of weight was noticed at harvesting, but they survived the ordeal of the attack and a certain weight was recorded to their credit at the close of the season.

The fertility of these eggs, of which at least 2,500 were tested over the whole of the above period of time, was shown to be well over 80 per cent. This would indicate that if all the eggs as laid persevered through to puparia, the percentage of sound plants at the end of the season would be practically nil, despite the fact, as above noted, that the season was light in comparative prevalence.

Our field records, however, from careful root examination of both cabbages and cauliflowers, show clearly that during the past season rarely, if ever, were more than 25 larvæ and puparia found at any one time. In other years I have taken as many as 100 larvæ and puparia from single roots of cabbages, but not so this year, which is comparable to the egg deposition records in Table A.

The question then arises: What happens to all these eggs and small maggots?

One answer is that it is probable the larval mortality is high in the very early stages. I have experienced difficulty in bringing through young larvæ from the eggs under laboratory conditions, and further from observations taken on the movements of newly-hatched larvæ on the surface of the soil, I am convinced a great many never reach the roots at all. However, I am not prepared to say much on this point.

One may judge from these statements that the fly was not so serious as usual, but, nevertheless, under such a degree of prevalence it was found that large numbers of eggs were laid, as indicated in the following table:—

TABLE A—EGG DEPOSITION RECORD.

Crop. No. Plants.	Dates or Month.	No. of eggs deposited, removed and counted.	Basis of 1 plant.
25 Radishes	April 17th–May 31st....	3,437 eggs	137.5
*12 Cabbages......	May 21st–May 31st....	86 "	7.
	For month of June	3,126 "	260.5
	July......	2,477 "	206
	August ...	758 "	63.2
	September	155 "	12.9
	October...	....	....
			Total..6,602
* 6 Cauliflowers...	June 25th–July 31st	2,221 "	370.
	For month of August...	1,555 "	259.
	September	1,311 "	218.5
	October...	428 "	71.3
			Total..5,515

Another answer is that of the control by parasitic insects. On several occasions the Cynipid parasite *Cothonaspis gillettei* has been bred from puparia collected in the field. Unfortunately we cannot, from our study up to the present time, consider this parasite of any practical benefit in the control of the fly at Agassiz, B.C., its numbers are shown to be entirely too few. From the large numbers of puparia that have been taken and studied this past summer, only twelve Cynipid adults appeared. They started to emerge from puparia on August 16th and continued until October 18th. Further, there is little doubt that some carry over the winter within the puparia of the maggot to emerge in the spring.

Except for this Cynipid parasite, no other true parasite has been observed or recorded in British Columbia.

The third answer to the above question, and probably the most important, is the control by predatory insects and mites.

RED TROMBIDIUM MITE.

A Red Mite may very commonly be found on the surface of the soil in the vicinity of cruciferous plants. It has been shown by laboratory experiments that this mite will attack the eggs of the Cabbage Maggot fly. Several investigators have shown mites of this nature of great importance in the natural control of the fly, but our studies at Agassiz do not show that it is of such importance and not comparable in usefulness to certain Carabid and Staphilinid beetles.

Several Staphylinids are of importance, notably:

Orus punctatus Casey.

Xantholinus hamatus Say.

Hisperobium californicum Lec.,

* (Cabbages and Cauliflowers transplanted on May 13th and 14th)

and several species of Carabids, notably, *Celia farcta* (1)*, *Bembidium mutatum* G. - H., *Bembidium trechiforme* Lec., *Platynus cupreus* Dej., *Pterostichus lucublandus* (2)*.

An attempt was made to determine the appetites of some of these predaceous insects. The following methods were used in determining this point. Ordinary small vials were employed in which single specimens of beetles were placed. A small piece of moistened blotting paper was also inserted in the vial and the whole tightly corked. Eggs of the Cabbage Maggot fly, freshly-hatched larvæ, and more mature larvæ of varying lengths were placed in the vial on the blotting paper ever so often, and allowed to remain with the beetle under observation. Daily records were taken over a certain length of time and the amount of material devoured noted. In this way we have the maximum appetite of the beetles recorded.

Another system was employed in which two ordinary microscopic slides were laid over one another and kept separate by means of a small strip of thin linoleum placed around three sides and glued on both sides to the glass. The fourth side was left open to be plugged with a piece of cotton wool. In this way we have a flat glass-encased chamber which may be easily handled and operated under the microscope. A little pulverised soil was then sifted into the chamber thus formed and the beetles to be observed placed within. Food was regularly supplied and the amount devoured recorded.

It may be seen from both these systems that the beetles were confined within a small area and that the food supplied had no opportunity of escape. Hence due latitude must be given the appetite record. Attempts were made to carry on the work under more natural conditions, but it was felt that the results recorded were of little value. It was too difficult to give the beetles full liberty of action and at the same time keep them under observation. Furthermore, it was impossible to discover whether a small newly hatched larva had been actually devoured by the beetle when given full liberty of action, or whether it had died a natural death. It is true that we devised a cage over some plants in the field, consisting of ordinary chicken wire mesh, which was entirely covered with cheesecloth, with the exception of a couple of inches on the ground surface. In this way the flies were prevented from oviposting and the ground beetles were allowed free access to the plants, and provided one knew how many eggs were around the plant at a given time, a series of notes on this point would offer some evidence on the matter of the natural control. However, even this method did not give the results expected.

I shall give, nevertheless, the results of the vial experiments, which may be taken to record the maximum appetite and the length of life of the beetles.

In this Table B the symbol "n, h, m," represents the words "newly-hatched maggots," while "l m" represents the words "large maggots." The figures in brackets in connection with these symbols represent the amount of food offered throughout the course of the beetle's life.

The species involved in this work are as follows:—

Type 1.—*Bembidium mutatum.*

Type 2.—*Bembidium trechiforme.*

Type 3.—*Pterostichus lucublandus.*

Type 4.—*Orus punctatus.*

Type 5.—*Xantholinus hamatus.*

Type 6.—*Hisperobium californicum.*

* (1) Identified by Dr. E. C. Van Dyke.
* (2) Identified by Col. T. L. Casey.

All the Carabids were actually observed at work devouring maggots in the field, hence are predacious on the maggot under strictly natural conditions. The Staphilinids occurred in numbers in such close vicinity to infested roots, that there is little doubt they also are predacious under natural conditions. Their habits were mostly studied in confinement.

TABLE B—CARABID ADULT APPETITE RECORD.

Beetle Type No.	Vial No. Exp.	Food Consumed. n, h, m,	Food Consumed. eggs	Food Consumed. l, m,	Life of beetle in days.	Food consumed per day. n, h, m,	Food consumed per day. eggs	Food consumed per day. l, m,
1	1	305 (352)	53 (71)	7 (13)	51	6	1	.5
	14	262 (319)	34 (46)	½ (8)	81	3.2	.4	.09
2	4	210 (308)	82 (116)	7 (19)	120	1.8	.8	.006
	6	51 (79)	21 (31)	2 (4)	12	4.2	1.9	.18
3	21	....	....	10 (23)	10	....	....	1.
STAPHYLINID ADULT APPETITE RECORD.								
4	2	497 (549)	78 (128)	1 (19)	87	5.7	1	0
	5	12 (12)	17 (22)	0	3	4.	6	0
	7	16 (25)	19 (38)	0	12	1.3	1.6	0
5	3	242 (313)	73 (112)	10 (22)	120	2	.2	.1
	9	185 (226)	10 (29)	0 (4)	76	2.5	.2	0
	10	165 (227)	45 (63)	0 (2)	51	3.2	.9	0
6	17	....	....	2 (5)	4	....	....	.5

To interpret the Table B correctly it is necessary to understand that the beetles were offered food according to what happened to be on hand to feed them, and further that on several days the beetles were deprived of their favorite food, i.e., small maggots and eggs and were fed on large maggots. In this way, in the first place, therefore, they were not allowed to choose their own food, hence the above record does not indicate any special choice of food, and in the second place while the beetles lived for some considerable time, part of that time they were starved, in the effort to induce them to devour the large maggots, hence the appetite record is lower per day than it would be if the diet had consisted entirely of small maggots and eggs.

The detailed daily record of these several beetles makes exceedingly interesting reading from the original notes. I do not consider it possible to include them in this paper, or to publish them in the proceedings, as they would occupy too much space. The Table B gives merely the bald statements without those fine points of interest incident to the feeding.

Control by Predacious Larvæ.

In addition to establishing the appetite record of the adult beetles, both Carabid and Staphilinid, an attempt was made to mature carabid larvæ. Carabid beetle eggs may frequently be seen on the soil surface, and at different times some of these were taken from the field, at other times some eggs were deposited in the tubes in the laboratory. Poor success seemed to attend the hatching of these eggs, and in fact many disappointments were encountered in bringing the larvæ to maturity. Without detailing all these troubles I will relate some of the facts obtained. The eggs and larvæ of these beetles were handled in the same way as the adults, in vials, etc.

Table C—Carabid Larvae Appetite Record.

Vial Exp. No.	Size of larva in mm.	Food consumed.			Remarks.
		n, h, m,	eggs.	l, m.	
11	hatched from egg		5 (5)	......	Larva died, having eaten 5 eggs in 2 days.
20&22	8 x 1	79 (100,	....	$6\frac{1}{2}$ (20)	2 Larva lived 20 days, having eaten per day 4 n,h,m, and 1 2 mm. maggot.
8	9 x 1	6 (6)	17 (37)	0	Larva died in three days.
12	9 x 1	2 (2)	4 (18)	......	Larva moulted and then died after 2 days.
15	12 x 2	....	7 (11)	4 (9)	Larva died after 3 days.
18	16 x 2	0 (20)	....	8 (28)	Larva died after 18 days, eating about 1, 2, 5 mm. maggot per day.

Summary.

Even from these records it is impossible to state with accuracy the actual appetite record of any predacious beetle or its larva. The limitation in the manner in which the work was done does not allow us to form any definite conclusion.

We are justified in stating, however, that despite the artificial methods employed, these predacious beetles present an immense aid in the control of the maggots. Their voracious appetites in confinement and from the fact that they did not hesitate to attack the food offered clearly proves some marked similar action in nature. Further than this, on many occasions, both Carabid and Staphilinid beetles, and the larvæ, at any rate of the former, may often be found embedded in the roots of plants in close association with maggots, and have been observed actually at work devouring maggots. The actual amount of food they dispose of in a day or throughout their life is the point of which we cannot be too sure from the records obtained. We might, however, be perfectly justified in assuming that five eggs or five young maggots a day would represent a normal appetite. We have also seen that a beetle will live with food for four months (120 days). On the above ratio it will destroy about 600 eggs or young maggots. This in itself would just about equal the number of eggs deposited by a fly on a single plant in a season, under conditions we have mentioned. Possibly this may be a little high, but nevertheless, we cannot avoid the fact that the percentage of usefulness of these little beetles is exceptional, and of unquestionable value.

The President: There are so many points to be discussed in these papers that I think it would be best to postpone the discussion until this afternoon, when we will have more time, and when Mr. Treherne will have more time to bring out certain points.

FRIDAY, NOV. 5th.—AFTERNOON SESSION.

The President: We will now commence the afternoon session and will first take up, before proceeding with the regular business, the discussion which was postponed this morning of Mr. Treherne's paper on the Cabbage Maggot. This paper is now open for discussion.

Mr. Tothill: I would like to ask if the headings "May," "June," "July," "August," and "September," etc., represent generations?

Mr. Treherne: Not in this chart. As a matter of fact, there are at least three generations of this maggot in British Columbia: the first generation ends about the end of May, the height of the second generation is early in July, and the third generation towards the latter part of August.

Mr. Burgess: I would like to ask Mr. Treherne if he has any definite records of the maggot coming through any stage in the winter.

Mr. Treherne: We have no larval or adult records of hibernation, but only as yet pupal records.

Mr. Gibson: With regard to the question that Mr. Burgess has asked, last year and the year before we made observations at Ottawa in the hope of getting further information as to how the insect passes the winter. We found the puparia abundantly in an old turnip field at varying depths, the lowest being nine inches below the soil. We only found what we considered the larva of the Cabbage Maggot fly in one instance, in April. The species in Eastern Canada most probably hibernates to a more or less degree in the larval stage, in addition to the regular hibernating form, namely, the puparium.

The President: The only other point, I think, which might arise from this paper which might be discussed is the comparative absence of internal parasites, particularly the absence of Staphilinid parasites such as we find in the East.

We will now proceed to the business meeting of this session, which consists in the election of officers. As in the case of last year, the Council in order to facilitate the proceedings of the meeting has recommended a list of officers for the guidance of the meeting, and I might ask the Secretary to read the list of officers as selected by the Council:—

President, Mr. A. F. Winn; Vice-President, Prof. L. Caesar; Secretary-Treasurer, Mr. A. W. Baker; Curator, Mr. J. B. Spencer; Librarian, Dr. Bethune; Directors, to be re-elected, with the exception of Division No. 6, where J. W. Noble is recommended.

Dr. Fyles: It gives me very great pleasure to nominate Mr. Winn as President of the Entomological Society. I have followed Mr. Winn's work for a number of years, and think he is fully capable of holding the position.

Mr. Morris: I second the motion.

Dr. Hewitt: It has been moved and seconded that Mr. Winn be elected President of the Society. I am sure it is a matter of great gratification to all Mr. Winn's fellow workers to see him occupying the Presidential chair. We all appreciate the work which he has done in the Province of Quebec, especially in the production of those excellent insect lists which he is getting up. There being no other

nominations, I declare Mr. Winn duly elected. I will call now upon Mr. Winn to take the chair.

Mr. Winn: I certainly do not deserve this honour. I never got it correctly into my head how I came into this office. Two years ago the Fiftieth Annual Meeting was held at Guelph and I was on hand. About two months later Mr. Gibson surprised me by telling me that I had been elected Vice-President, and as it was then too late to undo what seemed an inexplicable error, I came to the conclusion that an honour to the Montreal Branch, with which I have been connected since a schoolboy, was intended rather than on account of anything I may have been able to accomplish personally. It has been suggested to-day that in reality it is a form of punishment meted out for not attending all our meetings regularly.

In some of our sessions reference has been made to the work of professional or practical entomologists, and that of amateurs, who by inference are unpractical, as if there were two well marked divisions. Really I do not think such a distinction exists except in the application of the results obtained. If it does exist, I hope it will cease and that our Society will remain united from Atlantic to Pacific as we see it here to-day, and that some of those who attended our fiftieth anniversary will also be present at the one hundredth.

There is one point in particular that both the so-called divisions agree upon, and that is the importance of learning the life-histories of insects from the egg to the perfect stage, and this has been emphasized in nearly all the papers we have been listening to. This point reminds me of a matter about which I had some correspondence with Dr. Bethune a few years ago—the question of having a suitable crest and motto to use in connection with a book-plate, for, old as our society is, it cannot boast of owning either, "Ab ovo usque ad imaginem"—from egg to imago. No particular insect was mentioned to serve as an emblem, and as I do not know what views the members have on the subject, suggestions would be acceptable.

I feel sure, however, that thoroughness in following out the life-histories of insects, thus getting at the bottom of things, is one of the most important objects to keep before us, for we do not really know an insect till we know it in all its stages.

I shall not take up any more of your time except to thank you very sincerely for the honour conferred upon me.

The President: I think all who have had to do with the society have been impressed with Professor Caesar's ability. I do not think we could have a better Vice-President in support to Mr. Winn than Professor Caesar, and I have much pleasure in moving that Professor Caesar be elected Vice-President.

Seconded by Mr. Swaine. (Carried.)

(For complete list of officers see p. 6.)

Mr. Winn: I will now ask Mr. Sanders to read his paper on "Some of the Methods followed in Nova Scotia in controlling the Brown-tail Moth."

Mr. Sanders' paper read.

SOME OF THE METHODS FOLLOWED IN NOVA SCOTIA IN CONTROLLING THE BROWN-TAIL MOTH.

G. E. SANDERS, FIELD OFFICER FOR NOVA SCOTIA, DOMINION ENTOMOLOGICAL LABORATORY, ANNAPOLIS ROYAL, N.S.

The control of the Brown-tail Moth in Nova Scotia presents many difficulties peculiar to that Province which go to show in rather a striking manner the value of investigating each insect locally, in the light of a knowledge of local conditions and methods, extending even to such details as the method of fixing charges for packing out the staple crop in the warehouses.

The Brown-tail Moth has not yet become established in the forest areas of Nova Scotia, 92.6 per cent. of the total number found in the Province being on fruit trees; the few found on ornamental and forest trees being on trees near to or in orchards.

AREA INFESTED.

The area infested with Brown-tails is about two hundred miles long and some thirty miles wide, including the Counties of Shelburne, Yarmouth, Digby, Annapolis, Kings, Hants and Cumberland; or, in other words, all but one of the Counties of Nova Scotia touching on the Bay of Fundy.

This area may be divided roughly into four districts, in each of which we have a different proposition. In the first district, which includes Cumberland, Shelburne, Yarmouth, and all but a small section of the east end of Digby, we have small orchards averaging less than twenty apple trees each; usually the orchards are separated from each other by strips of woodland or open fields. As apples in this section are grown on a very small scale, as a rule for home use only, practically no spraying is done.

In the second district, which includes Eastern Digby and Annapolis County as far east as Annapolis town, we find apple trees in profusion. This district was settled about the time of the American Revolution, and many old, gnarly trees remain of the orchards planted by the original settlers. The land throughout this section is full of granite boulders, and in common with all such land in Nova Scotia and roadsides, fence-rows, pastures, and even scrubby woods are filled with seedling apple trees of every age and description. As this district is for the most part the west end of the Annapolis Valley, it falls into the regular fruit district and the orchards are of moderate size, covering probably one-tenth of the cultivated land, and adjoin each other quite closely. In spite of the natural advantages that this section possesses in the production of fruit, very little care is taken of the orchards, not more than 5 per cent. of the trees being sprayed.

The third district extends from Annapolis to Middleton. The western end of this section is granite land similar to the second district, and seedling apple trees are to be found everywhere. Over 50 per cent. of the cultivated land is in apple trees, so the whole district is practically one continuous orchard. About seventy per cent. of the orchard in this district is sprayed.

The fourth district extends from Middleton to Windsor, and includes the largest orchards in Nova Scotia, probably sixty per cent. of the cultivated land being in orchard, with the exception of a small section south of Wolfville, seedling apple trees are almost unknown. The orchard is for the most part less than fifty years old, orchard that a man can spray or inspect for Brown-tail easily; and, according to Prof. Brittain's census, some 87 per cent. of the trees in the district are sprayed.

Comparison of Controls.

In the first district, Yarmouth and Digby Counties, where the orchards are small and widely scattered, we find it very easy to control the Brown-tails by having our inspectors pick the nests from the trees in the winter. One inspection of this district can be relied upon to give a decrease in ordinary years, the only increases coming from the adult moths, which occasionally are blown across the Bay of Fundy into the district from the New England States. This district is on the whole flat country, and the normal increase very small. Evidently the adult moths are for the most part blown out of the orchards in which they originated, and the orchards being scattered they perish before they find other apple trees.

In the fourth district, Kings County, etc., the orchards are large and practically continuous, so if a moth is blown out of one orchard it will more often than not blow into another. In spite of this the large amount of spraying done, and the scarcity of seedling trees makes it quite easy for our inspectors to keep the Brown-tail within reasonable bounds. Occasionally we have small outbreaks in the western end of this district, but a little persuasion usually results in the orchards being sprayed and the Brown-tails exterminated.

In the third district, which is situated in the eastern end of Annapolis County, where 30 per cent. of the orchard is unsprayed and we have a great quantity of wild seedling apple trees, we have great difficulty in controlling Brown-tails. In many sections we have had very large increases which we followed up by very careful work, often persuading the owners of the worst orchards to spray, and so obtained decreases in infestation.

In the fourth district, or Western Annapolis County, with practically no spraying, medium-sized orchards and plenty of wild seedling apple trees, we have had great difficulty in holding the Brown-tails. Practically all of the work there has been done by our inspectors with no appreciable assistance, either in spraying or in picking nests, from the inhabitants.

Normal Increase in Nova Scotia.

The coldest season ever recorded in Nova Scotia was 1913-14. The extreme low temperature in the Annapolis Valley was—21F. at Kentville, while at Yarmouth the lowest was —6.4F.; in the most heavily infested district, *i.e.*, near Annapolis, the lowest temperature ran —19F. and less here. Brown-tails came through with an average of about 40 per cent. winterkill. Counting the actual number of nests within twenty-five yards of old nests found in 1914-15, including those that gave no progeny, we found the actual increase the Province over to average 6.3 new nests from each old nest—this was not counting the number of female moths that had blown over twenty-five yards from the old nests. The increase in ordinary years is much larger than this.

Winter Drop of Nests.

Formerly we started the inspectors at their winter work on January 1st, but we found at that time a very large proportion of the nests hanging by a thread, and a few of the nests gone, leaving a bit of web attached to the tree where the nest had been. We placed some nests on the ground and found that the young larva lived over in them with a very small winterkill. In fact, at one station where all of the Brown-tails suspended in the air were killed by the winter, those on the

ground lived over with only a small winterkill, having been protected from the extreme cold by the deep snow.

The questions that arose from this were: The proportion of nests that dropped from the trees, when they dropped, and whether the larva which lived over in the dropped nests would reach the trees from which they fell. We have not by any means finished these lines of enquiry, but we have one year's work on each, which shows up their importance.

On November 1914-15 we tagged a number of nests in each of two orchards, and in one we got 10 per cent. dropped during the winter, and in the other 25 per cent.

In regard to the time that the greatest drop takes place the heavy gale of Sept. 26, 27, 28, 1915, loosened a great quantity of nests, but the greatest drop appears to take place in November and December, soon after the leaves fall, and continues to a certain extent all winter. The heavy gales break down the nests and cause them to start swinging, but do not actually blow as many off the trees as one would expect, but the lighter winds following, constantly twisting the nests about, gradually wear the thread off and cause the drop to be spread quite evenly over the whole season.

In regard to the young larvæ in the dropped nests finding the trees, we found, from nests placed equidistant from four trees in an orchard planted 35 by 35 feet, that 11 per cent. of the larvæ contained in the nests found the trees and ascended to a tanglefoot band placed to catch them. The spring weather influences the movements of the young larvæ to a very great extent. In bright weather the larvæ will travel over the ground due south, toward the sun; in cloudy weather, such as we had when the larvæ were emerging in 1915, they will travel in any direction.

These preliminary investigations would indicate the importance of removing as many nests as possible before the nests begin to drop from the trees. These views are supported in practice by the ease with which the Brown-tails are controlled in districts where the drop is light, as compared with districts where the drop is heavy.

We now start our inspectors on November 1, when the leaves are about 90 per cent. off the unsprayed orchards, but have scarcely started to come off the sprayed orchards. They work the unsprayed orchards in the most heavily infested territory first, trying to get just as many nests as possible off the trees as quickly as possible, returning later to work every tree and bush in the district, and, if they have time, to return a third time to go over the trees again. As light and moisture conditions often prevent the best work being done in many orchards, a second thorough inspection is found to be of value in the most heavily infested localities.

Fall Picking of the Nests.

We have found that a large proportion of the winter nests can be gathered by the pickers when picking the apples in September and October, the cluster of brown skeletonized leaves that the larvæ feed on when forming the winter nest showing up for a foot around the nest against the dark green of the tree. At the beginning of the season we published notes in the papers requesting growers to have their pickers look for these clusters of leaves and destroy the nests when found. We have already had reports of a large number of nests collected and destroyed this season by the pickers.

Educational Work.

In addition to having our ten inspectors collect as many nests as possible from the trees, we plan to have them carry on as much educational work as possible, in order to persuade growers to examine their own trees and collect Brown-tail nests and to spray. All of our inspectors have all available data in regard to spraying right at their finger tips, and they are instructed to see the owner of every property giving over five Brown-tail nests, and endeavor to get him to spray his trees the next season.

More Spraying Campaigns.

The one thing outside of the work of our own inspectors in collecting nests that has had an appreciable effect in Brown-tail control has been the campaign for more spraying. In this we have the co-operation of the United Fruit Companies, whose warehouses extend over the whole fruit district, and of the Dominion Fruit Inspectors, who, under the Dominion Fruit Commissioner, Mr. D. Johnson, are now inspecting most of the fruit in the orchards and warehouses instead of at Halifax, so they come in direct contact with the growers and are a tremendous power in causing more spraying to be done. I am this winter spending two or three days with each of these inspectors, visiting warehouses, etc., and keeping them supplied with data on spraying. Mr. Johnson tells me that he wants his inspectors to be an educative rather than a police force—that they can do more good in showing people how to grow better fruit than, as he puts it, "going at the grower with a club to fine him if possible."

This attitude deserves the very highest commendation, and in teaching the Nova Scotia growers how to produce good fruit he must teach them how to control Brown-tails, for spraying, which controls the Brown-tail, is absolutely necessary in the production of good fruit in Nova Scotia.

The manager of the United Fruit Companies, Mr. A. E. McMahon, and his officials have been untiring in their efforts to get more and better spraying done, and their work has been particularly effective. About 60 per cent. of the total crop of Nova Scotia is handled through the 48 warehouses of the Companies, and all of the spraying material for their members is purchased by them. On their 60-ton order of lead arsenate, with other spraying material in proportion, they are able to get the very finest prices possible, and they give their members the full benefit of these prices and sell to non-members at a price that will barely cover expenses, preferring to take their profit in the benefits their members will receive from having their neighbors spray. The Fruit Companies' Inspectors, who visit every warehouse at least once a week, the warehouse managers and the packing foremen are every one active advocates of spraying, and persuade a great many people to spray by calling them into the warehouse when their poor lots are being packed out and comparing them with other well-sprayed lots.

The companies are also proving themselves of great value in the spraying campaign, by changing the methods of charging the cost of packing. In all of the warehouses, no matter under what system they are run, the culls, owing to the difficulty in apportioning them, are confiscated by the company and sold to be credited against general cost of packing. In most of the old companies the members were charged on the pack out of apples, that is, a member who delivered 50 barrels of apples from the trees which packed out 40 barrels of shipping apples, paid the same as the member who delivered 100 barrels, which packed out 40 barrels of shipping apples, the culls in both cases being confiscated, the larger

amount of culls about offsetting the extra cost of packing. In some of the last formed companies the cost of packing was charged on the number of barrels delivered at the warehouse, so that the man who delivered 50 barrels which packed out 40 paid only one-half as much as the man who delivered 100 barrels which packed out 40, the culls still being confiscated. The companies that operated under this last system had no difficulty in persuading their members to spray. When a man has to buy a barrel costing 26 cents for cull apples, pay 20 cents per barrel for having them handled, and then have the apples confiscated, it is quite easy to persuade him to spend 15 cents per barrel on spraying, and make shipping apples of them. Where the last system is operating, spraying is increasing rapidly, and the executive of the United Fruit Companies are gradually persuading the subsidiary companies to change over to the last system, as they find it the very strongest argument they can use in getting more spraying done.

These three complete and far-reaching organizations, some of which are in direct personal touch with almost every fruit grower in the valley, at least once a month have, to use a military phrase, "to be kept in ammunition." We are carrying on a number of experiments and observations to find out just what insects are doing the most damage, the extent to which each can be profitably controlled, the profits derived from controlling them; the actual cost of spraying; the best nozzles to use and the best materials to use. In this work we have the co-operation of the Provincial Entomologist, Prof. W. H. Brittain, who has taken over the investigations on the sucking insects of the apple, leaving the biting insects to the Dominion Laboratory. We have demonstrated that in an ordinary orchard in the Annapolis Valley, the benefit derived from controlling bud moth, fruit worms, and Codling Moth will pay for the entire cost of spraying, at least twice over; in addition the grower has his insurance against blackspot or scab free, and the most progressive of the Nova Scotia growers are now realizing that they cannot operate an orchard profitably in the Annapolis Valley without spraying.

Newspaper Work.

The *Co-operative News,* a paper conducted by the United Fruit Companies, and mailed to every one of the members of the Companies, or about sixty per cent. of the growers in the Annapolis Valley, twice a month, has reserved a page for any articles we may choose to write or solicit on spraying problems. By this means we are able to publish timely articles, give advance notice of insect outbreaks and methods of combatting them, as we will do with the Tussock Moth next season; give the growers the benefit of our findings just as soon as we are sure of our results, and have our papers and articles in handy form for the use of our inspectors, in carrying on their personal canvass for more and better spraying.

The work in increasing the amount of spraying, we realize, is the most important part of the work of controlling Brown-tail in Nova Scotia, and a large portion of the summer is devoted to spraying experiments and demonstrations, in order that we may devise the most economical sprays possible for Nova Scotia, as the cheaper and more effective the spray is, the more growers we can persuade to use it.

Spraying to Control Brown-tails in the Fall.

For two years we have been working on the possibility of controlling Brown-tails with the last summer spray, and this year we demonstrated that where arsenate of lead is used with Lime Sulphur in the last summer spray, or that applied from June 28th to July 15th, the poison will adhere to the leaves enough to poison the young Brown-tails when they emerge from the egg and start feeding in August.

Parasite Work.

In addition to the spraying, which will control more and more Brown-tails every year, as the amount of spraying increases, Mr. J. D. Tothil, of the Entomological Branch, is supervising the colonizing of the various parasites. Besides the colonizing of parasites, we have devised in Nova Scotia a practical means of preventing the reducing in numbers of the imported parasite *Apanteles lacteicolor* by the destruction of the winter webs of the Brown-tail. We build a large matched board cage, about 5 feet high, 6 feet wide, and 12 feet long with an open top and earth floor; two narrow boards are placed edgewise on the inside, and tanglefoot placed on the underside as in the Fiske tray. All of the Brown-tail webs collected are saved, and each of these cages stocked with two or three thousand of them. The Brown-tails are fed on short, leafy twigs for about three weeks in the spring until the first Apanteles larvæ emerges to spin its cocoon, then they are fed on willow catkins three or four times a day, giving them plenty of food so as to have as little Brown-tail web as possible in the food containing the Apanteles cocoons. The willow catkins seem to be the best material we can find for the Apanteles to pupate in. After about one week's feeding on catkins and the majority of the Apanteles have emerged, we feed broad leaves of some sort, heavily dusted with Paris green. Two days feeding will usually kill all of the Brown-tails, and then the green poisoned leaves can be rolled off to one corner and the willow containing the Apanteles cocoons exposed, so that the adults can fly free as soon as they emerge.

OBSERVATIONS ON THE BROWN-TAIL AND GIPSY MOTH SITUATION IN RELATION TO CANADA.

J. D. Tothill, Field Officer, Dominion Entomological Laboratory, Fredericton, N.B.

The parasites and predators that Mr. McLaine has just spoken of are being introduced of course as a measure of protection against possible injuries in Canada from the Gipsy and Brown-tail Moths.

How great a nuisance these two insects could become under Canadian conditions is not known. The farther north they travel the more vigorous will be the climate and the general conditions for existence. Somewhere between their present range and the arctic zone they will cease to be injurious. If the exact location of this "somewhere" could be precisely forecasted, fewer difficulties would no doubt be experienced in dealing with the spread of the infestation in the future.

The Brown-tail Moth, the less serious insect of the two, is now endemic in the transition zone of Nova Scotia. This indicates that this insect could become, if once established, a serious pest in all parts of the Dominion falling in this zone. In the middle west, however, food supplies would be inadequate and the insect would not be expected to flourish. The endemicity of *Euproctis* in the transition zone of Nova Scotia indicates, therefore, that the insect would also be a pest in the transition portions of British Columbia, Alberta, Ontario, Quebec, New Brunswick, and Prince Edward Island, if it once became established in any of these places.

In boreal parts of New Brunswick, and most of the Province is boreal, the same insect is epidemic. It remains to be seen whether or not it will become endemic.

The Gipsy Moth is a very serious shade tree and forest insect of the transition zone. It would undoubtedly flourish were opportunity afforded in the transition zone of Canada, excluding again that part of it falling in the treeless region of the middle west.

The behaviour of this insect in the boreal life zone cannot be forecasted. In this zone Mr. F. H. Mosher has shown that the insect would have an abundant food supply. It is also known that the insect hibernates successfully in boreal parts of Northern Maine. These two straws seem to show the direction in which the wind is blowing; they seem to show that there is a very grave danger menacing over immense boreal forests from attacks by this insect.

It is primarily to affect this seeming danger that the parasites and predators are being introduced.

They are being hibernated at strategic points, that is at points in Canada nearest to the infested area in New England and nearest to international trade routes. One of these points is near the international boundary in southern Quebec; another is in New Brunswick, and a third in Nova Scotia.

During the last four years large numbers of these beneficial insects have been introduced at these places. One of these species, *Apanteles lacteicolor,* is doing well in its new environment; another, *Compsilura concinnata,* is expected to be doing well, the third, *Calosoma sycophanta,* is known to be at least holding its own.

These same insects in New England are now helping materially and perceptably to relieve the situation.

It is hoped that by the time the Gipsy Moth reaches the Dominion there will have developed a living wall of its natural enemies strong enough to prevent disastrous results.

THE WORK CARRIED ON IN THE UNITED STATES AGAINST THE GIPSY AND BROWN-TAIL MOTHS.

A. F. Burgess, in Charge of Moth Work, Bureau of Entomology, United States Department of Agriculture.

The Gipsy Moth and Brown-tail Moth work in New England, as most of you know, is carried on in each State concerned by State and local agencies. Work to prevent the spread of these moths outside the territory where they now exist is maintained by the United States Department of Agriculture through the Bureau of Entomology. All of the work is of importance, as upon its thoroughness depends the chances of these insects spreading rapidly to the Dominion of Canada. The Brown-Tail Moth flies strongly and is attracted to lights and has already become established in districts in Nova Scotia and New Brunswick. The Gipsy Moth does not spread in the adult stage, but the small caterpillars may be carried long distances by the wind. Greater spread of this insect is shown toward the north and north-west. This is due principally to the fact that the prevailing warm winds during the time the small caterpillars are active blow from the south and south-east. A large number of men are employed in the outside part of the territory to scout the area for the purpose of determining how far the gipsy moth has spread and to treat carefully the infestations in the outside towns. This work consists, aside from scouting and creosoting of egg clusters in the winter, of thinning out infested areas where trees are growing too closely, or where the stand is

of favored food plants, and of destroying the caterpillars in the spring and early summer by the use of arsenate of lead spray and the application of bands of tanglefoot. This work has an important bearing on the spread of the Gipsy Moth. If tanglefoot bands are applied to trees before the caterpillars hatch it serves to keep any of those that may hatch from egg clusters on the ground from climbing to the tops of the trees and being blown long distances and establishing new infestations.

The territory inside the area known to be infested by the Gipsy Moth as well as that infested by the Brown-tail Moth, has been placed under quarantine by the Federal Horticultural Board, in order to prevent the shipment of trees or plant products which might disperse these insects to uninfested territory. For the purpose of enforcing these quarantines the infested territory is divided into sections in each of which an inspector is located, whose duty it is to examine all such plant products, as well as stone and quarry products which are shipped outside the infested area. This work has prevented the dissemination of the Gipsy Moth and Brown-tail Moth to many widespread areas. In connection with the inspection work, as related to the Brown-tail work, it should be of interest to residents of the Dominion to know that during the past three years inspectors have been maintained at junction points where long distance trains have passed out of the infested area in order to examine the trains and destroy any Brown-tail Moths that might be attracted to the lights. Large number of moths have been destroyed as a result of this work, especially heavy infestations having been destroyed on trains passing through White River Junction, Vermont, north bound.

Other phases of the work carried on by the Bureau of Entomology are largely experimental.

Silvicultural experiments are being carried on to determine the most resistant stands and the best composition of tree growth to withstand continued Gipsy Moth attack.

The parasite work was first begun in Massachusetts by a co-operative arrangement between the State and the United States Department of Agriculture. Parasites attacking these insects in different stages were imported for several years from Europe and Japan, and up to the present time, several species have become firmly established, and progress has been made toward checking the increase of these pests.

As has already been stated by Mr. McLaine, three of the species concerned, namely, *Apanteles lacteicolor, Compsilura concinnata,* and *Calosoma sycophanta,* have been introduced into Canada during the last two or three years, as a result of a co-operative arrangement between Dr. Hewitt and the Bureau of Entomology. These species have become so abundant in certain sections of the infested area that they can be collected in considerable numbers in the field, and they are secured in this way for colonization in areas where the species are not known to exist. This work is also being done by the Bureau in order to bring about the rapid establishment of these insects in the infested area.

Apanteles lacteicolor, which is a parasite of the Gipsy Moth, as well as of the Brown-tail Moth, has been colonized over practically all the area where these species are now known to exist. During the past year, many colonies were liberated in eastern Maine, and it is not considered necessary to make liberations next year.

Compsilura concinnata has been colonized over a slightly smaller area. It attacks both the Gipsy and the Brown-tail caterpillars, and more colonization will be necessary, particularly in eastern Maine next summer.

The spread of *Calosoma sycophanta* has been slower than the other species previously mentioned, although they are present in practically all the territory that

is badly infested with the Gipsy Moth. Further colonization will be necessary next summer.

In addition to the parasites already mentioned which are the most prominent that have been liberated are two parasites of Gipsy Moth eggs, namely, *Anastatus bifasciatus* and *Schedius kuvanæ* which are doing excellent service. These tiny insects spread slowly, hence it is necessary to liberate large numbers of colonies. By the end of another season it is hoped that the area most heavily infested with the Gipsy Moth will have been thoroughly colonized with these species.

Since the work was begun at the Gipsy Moth Laboratory, an effort has been made to learn as much as possible concerning the life history and habits of the parasites introduced, as well as their behavior, both under laboratory and field conditions.

The principal effort that has been made, however, has been to secure all information possible that had any bearing on the methods of successfully colonizing the species in the field, and obtaining information which would enable the work to be intelligently handled.

Since it is not deemed necessary to recolonize the area where the parasites are known to exist, a limited amount of time has been given to studying more closely the habits and relations of the introduced species and of our native parasites as well as native hosts. This work is showing some interesting results, but much of the data is far from complete.

In closing, I would like to express my pleasure at the cordial and satisfactory relations that have already existed between the work which is being carried on at Melrose and that which is under the direction of Dr. Hewitt. A hearty spirit of co-operation has existed among the men connected with the work and most satisfactory results are being secured.

Mr. Gibson: I would like to ask Mr. Burgess what the total number of food plants now is upon which the Gipsy Moth feeds?

Mr. Burgess: I cannot say just at the present moment but there are a large number.

Mr. Treherne: We took some specimens of Gipsy Moth from Japan a few years ago. Has a study been made of the parasites of this insect there?

Mr. Burgess: There has been some work done in Japan on the Gipsy Moth. Professor Kincaid from the University of Washington made a trip to Japan for the Department some years ago and studied the Gipsy Moth to a limited extent while making collections of parasites for shipment to this country. As far as I know, that is the only study by an American that has been made of the Gipsy Moth of Japan. I should consider that it would be dangerous to import the eggs of the Gipsy Moth into any uninfested section of this country.

Mr. Winn: If there are no more discussions on the Brown-tail and Gipsy Moths I will now ask Mr. Gibson for his paper on "Locust Control Work with Poisoned Baits in Eastern Canada in 1915."

LOCUST CONTROL WORK WITH POISONED BAITS IN EASTERN CANADA IN 1915.

Arthur Gibson, Chief Assistant Entomologist, In Charge of Field Crop Insect Investigations, Department of Agriculture, Ottawa.

At the meeting of the Society held in Toronto in November, 1914, I gave an account of our experiments at Bowesville, Ont., with poisoned bran baits to control locusts.* Such work we considered very encouraging. During the present year, 1915, the Lesser Migratory Locust, *Melanoplus atlanis* Riley, was again enormously abundant in Ontario and Quebec Provinces and to a lesser extent the Pellucid Locust, *Camnula pellucida* Scudd. We were, therefore, able to conduct further experiments and to demonstrate the value of new poisoned baits which had not previously, under field conditions, been used in Canada.

Poisoned Baits Used in 1915.

In June last (1915) arrangements were made to conduct twenty-three experiments with various poisoned baits near Bowesville, Ont. Each experiment was on five acres and the land chosen was from adjacent farms upon which the Lesser Migratory Locust was exceedingly numerous. No poisoned bait had previously been used on any of this land. In addition to bran, shorts and sawdust were also used as carriers for the poison. Formulæ containing bran were easily mixed; shorts did not mix satisfactorily owing to the fact that it becomes sticky and lumpy which, of course, makes it more difficult to spread properly. Sawdust, if fairly well free of small pieces of wood, spreads easily, but in mixing the formulæ containing it care had to be taken to add the water slowly, as the sawdust does not absorb liquid as quickly as bran, otherwise the Paris green is liable to be washed off. In many districts where it is difficult to obtain bran sawdust may often be had for practically nothing.

The following table gives concisely the results of some of our experiments conducted at Bowesville:

*See Rep. Ent. Soc. Ont., 1914 (1915), pp. 97-100.

	Mixture	Crop (5 acres)	Weather	Infestation	Death counts per square yard, 10 made in each field, 4 days after application, beginning at one corner of the field and walking diagonally across to the opposite corner.				Cost of single application per acre including labour	Date of application
						Highest	Lowest	Average		
1	Bran, 20 lbs. Paris Green, ½ lb. Molasses, 2 qrts. Lemons, 3 Water, 2½ gals.	Millet, 6 in. high	warm and dry	Very heavy. Locusts in all stages. Some winged	75, 10, 7, 575, 10, 40, 100, 241, 70, 90	575	7	121.8	18½ cents	June 24
2	Bran, 20 lbs. Paris Green, ½ lb. Molasses, 2 qrts. Oranges, 3 Water, 2½ gals.	Pasture	warm and dry	Heavy. Locusts very active. Some beginning to migrate	155, 250, 163, 241, 54, 50, 65, 140, 200, 710	710	50	202.8	19 cents	June 29
3	Bran, 20 lbs. Paris Green, 1 lb. Molasses, 2 qrts. Lemons, 3 Water, 2¼ gals.	Oats, 9 in. high	warm and dry	Very heavy. Locusts active. Medium number of winged individuals	26, 736, 38, 300, 36, 50, 230, 100, 300, 25	736	25	184.1	21 cents	June 25
4	Bran, 20 lbs. Paris Green, 1 lb. Molasses, 2 qrts. Oranges, 3 Water, 2½ gals.	Oats, 9 in. high	warm and dry	Very heavy. Locusts active	819, 691, 84, 630, 121, 918, 63, 80, 540, 120	918	63	406.6	21½ cents	June 28
5	Bran, 10 lbs. Sawdust, 10 lbs. Paris Green, ½ lb. Molasses, 2 qrts. Oranges, 3 Water, 2½ gals.	Pasture	warm and dry	Heavy. Locusts from very small to winged state	127, 100, 15, 40, 360, 35, 30, 25, 100, 200	360	15	103.2	16½ cents	June 24

	Mixture	Crop (5 acres)	Weather	Infestation	Death counts per square yard, 10 made in each field, 4 days after application, beginning at one corner of the field and walking diagonally across to the opposite corner.				Cost of single application per acre including labour	Date of application
						Highest	Lowest	Average		
6	Bran, 10 lbs. Sawdust, 10 lbs. Paris Green, 1 lb. Molasses, 2 qrts. Lemons, 3 Water, 3 gals.	Oats, 6 in. to 9 in. high	warm and dry	Heavy. Locusts in various stages. Some winged	25, 400, 530, 44, 80, 60, 125, 90, 23, 15	530	15	139.2	18½ cents	June 25
7	Bran, 10 lbs. Sawdust, 10 lbs. Paris Green, 1 lb. Molasses, 2 qrts. Oranges, 3 Water, 2½ gals.	Oats, 6 in. to 9 in. high	warm and dry	Heavy infestation. Locusts active.	118, 116, 197, 33, 70, 258, 204, 200, 190, 104	258	33	149	19 cents	June 25
8	Sawdust, 20 lbs. Paris Green, ½ lb. Salt. ¼ lb. Water, 3 gals.	Oats, 9 in. to 12 in. high	warm and dry	Heavy. Locusts active. Many winged from adjacent uncultivated land	30, 121, 401, 46, 720, 650, 100, 35, 80, 100	720	30	228.6	7 cents	June 25
9	Bran, 20 lbs. Paris Green, 1⅛ lbs. Molasses, 4½ qrts. Water, 2 gals.	Oats, 9 in. to 12 in. high	warm and dry	Heavy. Locusts active.	246, 840, 509, 473, 210, 368, 230, 1,200, 616, 450	1,200	210	514.2	27 cents	June 30

From the above table it will be seen that in fields where mixtures Nos. 2 and 4 containing oranges were used, higher death counts per square yard were obtained. The mixtures in which sawdust was used are, indeed, very promising and further work with these mixtures will be conducted. The results obtained with mixture No. 8 are certainly remarkable and indicate the value of this new and very cheap poisoned bait. In the report of the Society for 1914,* Mr. Norman Criddle stated that he had experimented with sawdust and salt in Manitoba and claimed that with the salt and sawdust he obtained about the same results as with salt and bran. In the experiments tabulated above the highest death rate was obtained, as will be seen, in the use of mixture No. 9, which killed, on an average, 514 locusts per square yard of field.

As above mentioned each mixture treated an area of five acres. In the sawdust mixtures the amount of water necessary, of course, will vary with the dryness or otherwise of the material at hand. Two gallons may be sufficient, or more may be required. The carrier, whether this be sawdust or bran, should be noticeably moistened, not made into a mash, or moistened too much to prevent its being crumbled through the fingers. The farmers in general on whose lands the experiments were conducted were much pleased with the success of the mixtures. Those on whose fields mixtures 3, 4 and 8 were used have specially reported that the crops were saved by the treatment. In all of these experiments only the one application was made. The work of spreading the mixtures and making the death counts was satisfactorily accomplished by Mr. T. Rankin, a student assistant.

At Lanoraie, in Quebec Province, a series of similar experiments were conducted under my direction by Messrs. Beaulieu and Beaulne, officers of the Entomological Branch. Unfortunately, the work here was seriously interfered with by exceptional heavy and continuous rain and wind storms. In heavily infested fields where mixtures similar to Nos. 1, 2, 3 and 4, but with shorts instead of bran, the locusts were much reduced in numbers by the application, but the heavy rains which followed soon after the mixtures were spread made it impossible to make important observations as to the death counts. On June 17, mixture No. 6, as above, was spread in a field of oats. Five days later three counts only were made owing to a misunderstanding and these gave 300, 305 and 328 dead to the square yard. A heavy rain and wind storm took place between 3 p.m. and 9 p.m. on June 17, and undoubtedly many locusts which had fed on the mixture in the early morning were poisoned and later washed away by the deluge. On June 28, mixture No. 1 distributed over a pasture field resulted in an average of 129 dead locusts to the square yard. Sixteen counts were made across the field and on the date mentioned many of the insects were in the winged condition. On June 25 I visited Lanoraie and in a field of rye in which mixture No. 3 with shorts used instead of bran large numbers of dead insects were observed. The following counts in different parts of the field were made, 220, 635, 408, 235, 195, 523, 609, 395, 259, an average of 386 dead to the square yard. Dead locusts were found in numbers as far as 249 feet from the treated field.

Organization and Co-operation Necessary to Control Locusts Over Widespread Areas.

In 1915 the value of early organization to control serious outbreaks of locusts was strikingly illustrated in the Province of Quebec. In the Parish of St. Etienne de Gres where our Entomological Circular No. 5 had been freely

*Rep. Ent. Soc. Ont., 1914, p. 102.

distributed, and where control work had been conducted in 1914, the farmers organized under the immediate direction of Father J. I. Trudel, the resident Parish Priest and Agricultural Missionary. In this parish, practically all farm land—estimated at over 21,000 acres—was treated with mixture No. 1, using Paris green, however, in the strength of 1½ pounds for each 20 pounds of bran. The bran, Paris green, molasses and lemons were purchased in large quantities at wholesale rates, and the mixture distributed over the land during the week beginning June 4, at which time the locusts were from one-quarter to one-half an inch in length. Counts made a few days after the application in various fields ranged from 80 to 120 dead locusts to the square foot. I visited St. Etienne de Gres on June 23 and examined many of the treated fields. Comparatively few living locusts could be seen and the farmers generally were much pleased with the effectiveness of the mixture. Father Trudel estimated that 90 per cent. of the locusts had been killed. Of the area treated about 7,000 acres

Oat field at St. Etienne de Gres., Que., saved by one application of poisoned bait. (Original.)

were in oats. These crops, as well as fields of other grains and vegetables, were saved from destruction. According to the Parish Priest, not a single field was devastated and the pasture lands in addition were protected from injury. The cost of the application at St. Etienne de Gres was 15 cents an acre, exclusive of labor.

Following the advice given in our Entomological Circular No. 5, similar work was carried on in 1915 in the following additional parishes of the Province of Quebec: Mont Carmel, Pointe du Lac, St. Boniface de Shawinigan, and Almaville. The Quebec Department of Agriculture, I am informed by Mr. J. A. Grenier, Provincial Deputy Minister of Agriculture, made the following grants to assist the farmers in the purchase of bran, Paris green, etc.:

St. Etienne	$1,013 00
Mont Carmel	675 00
Pointe du lac	200 00
St. Boniface de Shawinigan	100 00
Almaville	100 00

I have already referred to the results obtained in the Parish of St. Etienne. In the Parish of Mont Carmel the farmers, under the guidance of Father E. Fusey, treated 7,400 acres, of which 2,000 acres consisted of farm land which had been abandoned owing to the continuous outbreaks of the locusts. In some fields, in 1915, crops of vegetables and grain were harvested for the first time in eleven years. The Parish priest reported complete success in the use of mixture No. 1, with Paris green used in the strength of 1½ pounds to the 20 pounds of bran, in his opinion 95 per cent. of the locusts having been killed. On June 22, I visited the parish and very few living locusts, indeed, were present in the fields examined. Mr. G. Beaulieu, Field Officer of the Branch, who was also present in the same district during the period June 20 to 29, could not find any fields sufficiently infested to enable him to undertake control experiments similar to those conducted at Bowesville, Ont. In some fields a second treatment was given owing to very heavy rains following the first spreading.

Part of abandoned farm, Valmont, Que., now a breeding ground for locusts. (Original.)

In the Parishes of Pointe du Lac, St. Boniface de Shawinigan and Almaville, similar satisfactory results were obtained and the farmers generally were well pleased with the poisoned bait, which certainly saved from destruction many fields of crops.

The question of the control of locusts is a very important one to many farmers in Eastern Canada, but we are extremely hopeful as a result of our experimental and field demonstration work, that the destruction of these insects in future outbreaks will be a comparatively simple matter—largely one of proper co-operation. Farmers living in districts where locusts are destructive should organize in early spring so that a sufficient quantity of poison, etc., will be readily available to distribute over the fields when the locusts are about the size shown at *a* and *b* of figure herewith of the Lesser Migratory Locust. The poisoned bait should be applied early in the morning (before or very soon after sunrise) on or about the same day. Twenty pounds of poisoned bait is sufficient to treat five acres. It is, of course, not necessary that the mixture be applied to all

of the land, but by scattering it thinly here and there throughout the fields sufficient of the bait will be distributed to attract the locusts from considerable distances. In the preparation of the bait it is wise to guard against the breathing of the fine particles of the Paris green. This may be avoided by tying a handkerchief, loosely, over the mouth and nose.

DR. FERNALD: I would like to ask if there were any experiments made as to the variation in number of the oranges and lemons.

MR. GIBSON: In every case we used only the three fruits to the 20 pounds of carrier.

MR. TREHERNE: In British Columbia we have a lot of range land. Last year we had about 100 square miles destroyed by the Migratory Locust, *M. affinis*. I would like to hear from Mr. C. P. Lounsbury on this.

Lesser Migratory Locust, *Melanoplus atlanis:* a, b, young hoppers; c, adult male; d, adult female. (Author's illustration.)

MR. LOUNSBURY: Our South African matters are so very different that I am afraid there would be very little advantage in my discussing them. All our work in South Africa for many years has been done with poisoned baits or spraying. We use arsenite of soda more than Paris green because it is cheaper.

We have never attained anything with the citrus fruits. Does the fruit juice add much to the attractiveness of the bait?

MR. GIBSON: The fruit juice is, of course, supposed to add to the attractiveness of the bait. We have never had any definite experiments to bear out this fact. In the case of the new sawdust mixture containing salt alone, the salt is undoubtedly the attractant.

MR. WINN: If there are no further discussions on Mr. Gibson's paper I will call on Professor Caesar to give his paper on "Apple Leaf-rollers in Ontario."

LEAF-ROLLERS ATTACKING APPLES.

L. Caesar, Ontario Agricultural College, Guelph.

On the discovery last year that in at least two well-cared-for commercial orchards much loss had been done by the Fruit-tree Leaf-roller* [*Tortrix* (*Cacœcia*) *argyrospila*], which has the last few years become a very troublesome pest in many parts of the United States, it seemed to me wise to study the habits and life-history of this insect in Ontario so that I might be in a position from actual experience to advise as to the best methods of control in case the insect should increase in numbers and attack more orchards. In this and other investigation work I had the assistance of my colleague, Mr. G. J. Spencer, for a few weeks, and of Mr. H. G. Crawford, a recent graduate, for the whole season. The investigations were conducted chiefly in the large apple orchard of Mr. Jas. E. Johnson, Simcoe, Norfolk County.

Species of Leaf-rollers Found in the Orchard.

We expected to find two species of Leaf-rollers [*Tortrix* (*Cacœcia*) *argyrospila*] and the Oblique-banded Leaf-roller [*Tortrix* (*Cacœcia*) *rosaceana*]. I knew, however, from the large number of unidentified egg masses on the trees that there was another insect present, but what it was I had no idea. Later on we found that it too, was a leaf-roller, which proved to be *Tortrix* (*Cacœcia*) *semiferana*, the Box-Elder (Manitoba Maple) Leaf-roller. We thus had three species working side by side.

A very peculiar circumstance in connection with our work was that though there were about 60 acres of large apple trees in one solid block, the three most important pests studied, the Fruit-tree Leaf-roller, the Box-Elder Leaf-roller and the Capsid (*Neurocolpus nubilus*) were all found together towards the centre of this orchard on a block of Spy trees of 6 to 10 acres in extent. Bordering rows of Baldwin trees were also attacked but those some distance removed, as also distant Spy and Greening trees, were very little injured. The explanation of this localization of insects is hard to discover. This part of the orchard had been in sod longer than the other parts but that scarcely seems sufficient explanation. Prof. Gillette has remarked upon the tendency of the Box-Elder Leaf-roller to appear at the same time and in the same neighborhood, but not on the same kinds of trees as the Fruit-tree Leaf-roller. It is well known that the latter very commonly centres itself in one locality injuring perhaps a single orchard severely and scarcely attacking at all another a few rods away.

Relative Abundance of Each Species.

Though the egg masses of *semiferana* were almost as abundant as those of *argyrospila* the larvæ of the latter were many times more numerous, at any rate towards the end of the season. This may have been due to the former species being less immune to poisonous sprays (Lugger of Minnesota reported that Paris green controlled this species) or to some other unknown cause. *Rosaceana* was not nearly so abundant even as *semiferana*. About nine-tenths of the total injury was done by *argyrospila*.

*Mr. August Busck states that the generic name "Archips" has been dropped and "Cacoecia" is tentatively retained as a subdivision of Tortrix.

Distribution in the Province.

Argyrospila is so common and so widely distributed all over the United States that it is not at all surprising to find that it exists almost, if not quite, all through the fruit districts of Ontario. I have either captured or reared adults from places here and there all the way from Ottawa to Norfolk County and feel sure I could, with a little searching, find them in almost all other fruit counties. This clearly indicates that it is by no means a new pest, but that through some peculiar absence of natural means of control has the last two or three years suddenly become a very destructive one in a few orchards and may yet become so in others.

Rosaceana was until the last couple of years considered our most common and destructive apple leaf-roller. It is seldom present, however, in large numbers. It, too, has existed all over the Province for many years.

Semiferana is very little known in Ontario. There is one specimen in the collection of the Ontario Entomological Society, but without any data as to where and when it was taken. A specimen was taken by Dr. Fyles at Levis, Quebec, and one is reported as being in Mr. Winn's collection, but he has no recollection of having seen or taken any. There is no record of it from Nova Scotia. In Ontario, Mr. Crawford and I have searched in several localities this fall for egg masses, but found none outside of the orchard at Simcoe. It is very probable, however, that a careful search of forests would show its presence in quite a number of localities, otherwise it is difficult to account for its abundance at Simcoe.

Host Plants.

At Simcoe we found the Fruit-tree Leaf-roller (*argyrospila*) preferred apple trees to any other kinds. A few were observed on pears, plums and peaches, and also on oaks. In the orchard it was seen that the larvæ fed freely upon almost any kind of succulent or moderately succulent weed beneath the trees. They were very fond, too, of the leaves and heads of clover and of vetch in such positions. A study of the literature on the subject shows that it has a very large number of food plants, including numerous weeds, forest and shade trees, and shrubs. So that it is by no means limited to fruit trees.

The Oblique-banded Leaf-roller (*rosaceana*) is found most commonly on apples and pears but from the list of host plants given by Slingerland and Crosby, which include several weeds and clovers, it must be almost as omnivorous as the Fruit-tree Leaf-roller.

The Box-elder Leaf-roller (*semiferana*) has never before, so far as I can find, been reported as attacking apples. A few wild cherries and currants beside Box-elders have been found by Lugger slightly infested. Its favorite food, however, is the Box-elder, often called the Manitoba Maple. In Colorado and Minnesota it has been reported as occurring at times in great numbers on these trees. It is recorded also from oaks and hickory.

Nature and Extent of the Injury Done.

So far as we could see from a single season's work, the feeding habits and injuries done in the orchard by all three species were so similar that a description of what was closely observed in the case of the Fruit-tree Leaf-roller will serve for all.

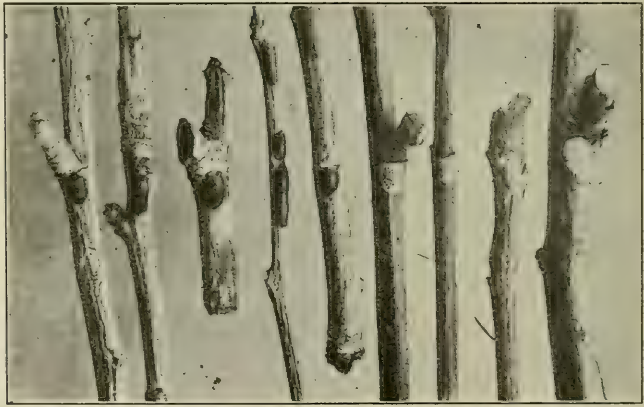
We were not able to begin our work until May 3rd and by this time the

majority of the larvæ had hatched and entered the opening leaflets of the infested Spy trees and were feeding on the interior. The larvæ had apparently begun to hatch, as stated by various writers on the subject, soon after the buds began to burst. By May 3rd, the leaflets were about one inch long but the blossoms were not yet ready to burst. Leaflets containing a larva inside were prevented by the silken threads from opening for some time. Later-hatching larvæ rolled the expanded leaves up, either the whole leaf being folded or only a portion of one side. When the fruit buds were ready to burst these were in many cases preferred to the leaves and the larvæ bored into them and fed upon the stamens, pistils or ovaries, thus destroying the promise of fruit. Sometimes, as the cluster of blossom buds opened, a silken web was spun around these and perhaps an adjoining leaf or two, and the larvæ fed on the parts inside the web. Under these circumstances the blossom stems were often cut off. When that was not done, the blossoms themselves were usually unable to open properly because of the web. When the fruit began to form many of the caterpillars deserted the leaves for this and ate large or small areas in it. Sometimes the areas were only shallow, but some-

Adults of (*a*) *Archips agryrospila;* (*b*) *A. semiferana;* (*c*) *A. rosaceana.* (All natural size.)

times they extended right through to the core. In the case of plums they often reached right into the pit. Almost all apples with very deep injuries dropped soon. The others, if they remained on the tree, were always more or less deformed and as a rule rendered culls. A callous growth with russet surface soon formed over the injured area and protected it from the air and rain. Feeding on small apples was usually done under some kind of protection, such as a leaf fastened by the larva to the apple or a little web spun over the hole made. When the larvæ fed upon the large expanded leaves they nearly always chose those last formed and therefore most succulent. These they rolled either upwards or downwards, about 66 per cent. being rolled up so that the upper surface was the enclosed one, the remainder being rolled the opposite way. Migration from older leaves to younger seemed to be quite common and helped to explain the difficulty of killing the larvæ by arsenicals. The larvæ, when in the large rolled leaves, fed either by eating holes through the leaves or by devouring the apical or basal portions, leaving the rest intact. When disturbed they readily dropped down by a single thread and usually crawled back to the leaf when all was quiet.

Where the larvæ were very abundant they did a great deal of damage both to the foliage and the fruit. Large numbers of the terminal leaves in such cases, especially on the top of the tree, were badly tattered and riddled by them, but none of the trees were defoliated as had happened in some cases in Colorado and elsewhere. In the orchard at Simcoe there was so light a setting of fruit on most of the Spy trees this year that it was difficult to form any estimate of the amount of loss. On one well-laden tree, however, of another variety in among the Spy trees fully 50 per cent. of the fruit was ruined either by the destruction of the fruit blossoms or by the killing of the young fruits themselves or by rendering much of what remained culls. In an orchard near Hamilton I estimated that some large Greening trees had fully 50 per cent. of the crop destroyed. Mr. Sexsmith of Trenton estimated that in his ten or twelve acre orchard the crop had been lessened fully 50 per cent. in the infested orchard both last year and this. Another orchard of his, and all the neighboring orchards visited by me, had suffered almost no injury. In Norfolk County we found only the one orchard at all seriously infested, though a few larvæ were to be found all through the district.



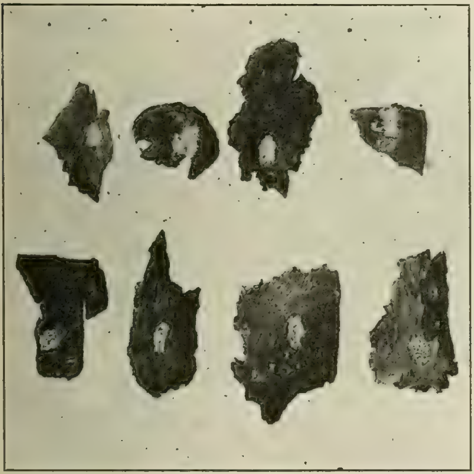
Egg masses of *A. argyrospila*. The four to the right have hatched. and are white; the remainder are unhatched and are dark brown. (Natural size.)

An examination of the only three badly infested orchards known to me showed that any variety of apple was subject to attack and that there was no reason to believe that there was any special attractiveness in the Spy over other varieties.

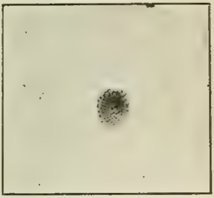
Brief Descriptions of the Adults of Each Species.

The adult of the Fruit-tree Leaf-roller is a moth with a wing expanse of from two-thirds of an inch to one inch. The general colour of the fore wings is a rusty brown with several silvery-white or silvery-gray markings which vary somewhat in different individuals, but are usually of the size and arrangement shown in the photograph. The hind wings are a light ashy brown color without any markings.

The Box-elder Leaf-roller adult resembles very closely in shape, size and whitish markings, the above species. It differs, however, from it in that the general color of the forewings is a much lighter brown, almost a fawn color. The hind wings in the former species contrasted strongly in colour with the fore wings but in this species they are practically the same pale brown or fawn color only a little lighter in shade. Moreover, the white markings, as seen in the photograph, usually continue farther in from the front margin forming in the case of two of them irregular oblique transverse bands reaching most of the way across the wing. In many males there is a noticeable dark brown spot, the size of the head of a pin, enclosed or nearly enclosed by white areas and situated in the middle of the front wing at about the outer part of the first third. There are some very light colored specimens in which the white markings are very indistinct.



Egg masses of *A. semiferana* on pieces of apple bark. Those in the upper row, with one exception, are unhatched; the remainder have hatched. (Natural size.)

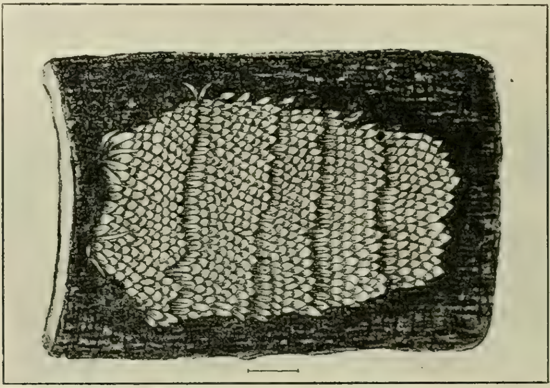


Egg masses of *A. rosaceana*, laid on glass. The little line to the side is a young larva just emerged from an egg. (Natural size.)

The adult of the Oblique-banded Leaf-roller is, as seen in the photograph, considerably larger than either of the above species though many specimens are smaller than those pictured. It can easily be distinguished from either species by the absence of white markings and by the front wings being a dull light brown with two wide darker brown transverse bands on the outer half running obliquely outwards from the front margin. The outer of these bands is sometimes incomplete. The hind wings are of a lighter brown than the front. There are some very pale specimens of this species, too, compared with the typical forms.

Description of Egg Masses of the Different Species.

All three species lay their eggs in clusters as seen in the photographs. The egg masses of the Fruit-tree Leaf-roller are roughly oval in shape, about three-sixteenths of an inch in length, and are covered with a protective secretion. They are, with very rare exceptions, laid on twigs of two or three years' growth, and commonly on some slight slope on these such as occurs at the base of a branch or fruit spur. They are nearly always deposited on the upper surface or sides of the twig, only two or three having been found on the underside. Freshly laid masses are yellowish green but soon turn dark brown, a little darker brown than the twigs on which they are laid. After hatching they gradually become grayish white and are then more easily seen. The little openings show where the caterpillars emerged. Old egg masses sometimes remain on the trees for two years before weathering away. Each egg mass contains an average of about 95 eggs, the smallest number found being 6 and the largest 143.

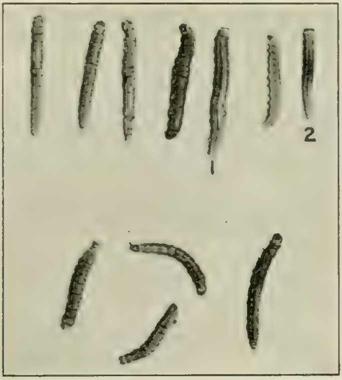


Egg masses of *A. semiferana* much enlarged to show the scales from the moth's abdomen that form the covering. (After Gillette.)

The egg masses of the Box-elder Leaf-roller are easily distinguished from any other egg mass likely to be found in that they are covered over with scales. We have not observed the female laying the eggs, but there seems no doubt that after she has deposited and covered them over with a sticky secretion she presses her abdomen down upon this secretion and leaves all the scales there arranged as in nature. This would lead us to infer that only one egg mass is laid by each female. The masses are, as seen in the figure, roughly oval, are a little smaller than those of the Fruit-tree Leaf-roller and are glossy cream in color. They usually appear to contain from 20 to 60 eggs. Unlike those of the first species the egg masses are not laid on twigs but chiefly in the axils of branches of from about one to two inches in diameter, and on the bark of the larger branches of 1½ inches and upwards in thickness. A few are found on the trunk. The eggs are usually placed in a slight depression on the bark.

Only four egg masses of the Oblique-banded Leaf-roller were seen. Two of these were laid on the glass in rearing cages (one of these is shown in the

photograph) one on a leaf in the orchard and another on the bark of a young apple tree. The mass is pale green before hatching and then becomes transparent and almost colorless. The eggs lap one over the other somewhat as shingles. The mass is a little larger than that of the Fruit-tree Leaf-roller and contains an average of about 100 eggs. When ready to hatch, as in the photograph, the black heads of the little larvæ show through the mass very distinctly and make it easy to count the eggs.



Full-grown larvae: 1 and 2 of *A. semiferana*, the remainder of *A. argyrospila*. (Natural size.)

Empty pupal cases (*a*) of *A. semiferana*, (*b*) of *A. argyrospila*. Note that the former are very much lighter in colour, often being nearly white. (Natural size.)

Comparison of the Larvæ.

The larvæ of all three species closely resemble each other both in appearance and habits, and therefore will not be distinguished by the fruit growers. In the early part of the season up to the time when the fruit begins to be attacked the larva of the Oblique-banded species will nearly always be the largest of the three because it reaches maturity earliest. It is, when full grown, nearly an inch long, green in color, with a black or blackish head and thoracic shield.

The full grown larva of the Fruit-tree Leaf-roller is usually more of a pale yellowish-green color; it also has a black head and thoracic shield in all stages except the last when these usually change to brown.

The full grown Box-elder larva is like the above two in being nearly an inch long. It is a very pale apple green color and can be distinguished from either of the above species by the head and thoracic shield being a whitish green instead of black. There is often a slight mottling of brown on these parts, and in some specimens at least, the segments are indistinctly divided by pale yellowish-white lines. There is a dark green line down the middle of the back.

Comparison of the Pupæ.

It does not seem worth while to go into details in regard to the differences between the pupæ, further than to remark that those of the Fruit-tree Leaf-roller and of the Oblique-banded species are brown, whereas those of the Box-elder species are whitish both before and after the adults emerge.

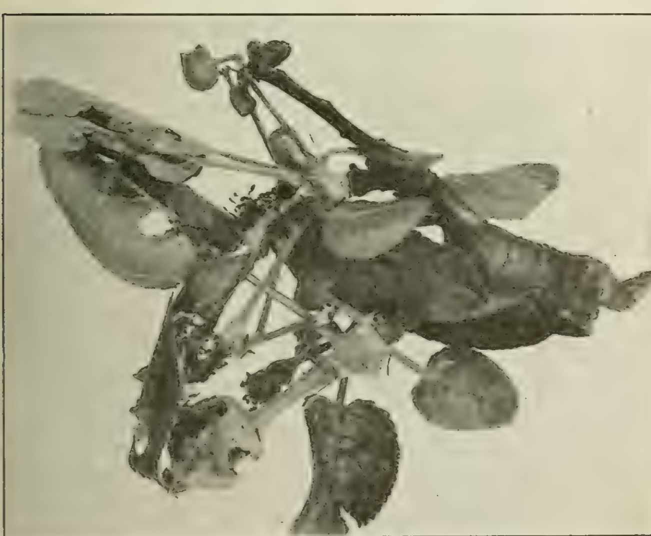
Life-Histories.

The winter is passed by all the species in the egg stage on the trees. We did not prove this of the Oblique-banded species because the larvæ of the second brood of this species all died in the cages, but Herrick, of Cornell, has shown that eggs are laid by the second brood adults and the winter passed in that stage. The eggs of all three begin to hatch near the same time, which is usually very soon after the buds are beginning to burst. Almost all those of the Box-elder Leaf-roller and also of the majority of the Fruit-tree Leaf-roller had hatched by May 3, which was a few days before the blossoms on the Spy began to burst. At this date the larvæ of these two species were still very small, being only about ⅛ inch long. Hatching of *argyrospila* eggs continued for a month, the last newly hatched larva being seen June 8th.

By May 25th the Oblique-banded Leaf-roller had begun to pupate and by June 10 the first adult was seen. The latter date was about two weeks after the blossoms fell from the Spy trees. The pupal stage of this species, judged from the few specimens reared, lasted about 13 days. The larvæ of the Fruit-tree Leaf-roller began to pupate about June 14, but larvæ were present for three weeks or more later. Adults were first seen in the orchard on June 26th. After this they soon became quite common. By July 12 they seemed to have reached the maximum, and then quickly decreased in number, the last being seen on July 22. The length of the pupal stage averaged 11.5 days. Adults in cages lived only five or six days.

The first pupa of the Box-elder species was found on June 26th, but there must have been pupæ earlier than this for adults were found on July 3rd, and cage experiments showed that the pupal stage lasted about 12 days on an average.

Young apples injured by Leaf-roller larvae. (Natural size.)



Work of Leaf-rollers on leaves and fruit clusters. Note the rolled leaves and the young dead fruit stems fastened to them. (Natural size.)

From July 3rd they increased rapidly and were still abundant July 20th, but soon after disappeared. They were seen, however, a week or more later in the orchard than the preceding species.

The above data shows that this year *T. rosaceana* adults began to emerge about two weeks earlier than those of *T. argyrospila* and the latter about a week earlier than those of *T. semiferana*.

Rosaceana and *semiferana* seemed to pupate almost invariably in the leaves, but much to our surprise fully half of the pupation of *argyrospila* either took place on weeds or in the grass or else the pupæ were shaken by the wind out of the leaves into the grass beneath. For instance, we spread a covering of cheesecloth, 8 x 10 ft. in size, on the ground beneath a tree on June 26th after emergence had begun and under this 320 pupæ or empty pupal cases were found and

Some of the parasites that help to control Leaf-rollers. On the left are Tachina Flies and their puparia; on the right Ichneumons.

upon it 84 pupæ, making a total of more than 400 which we estimated was a larger number than the total of the pupæ on the corresponding part of the tree above the sheet. There was no lack of food on the trees to force them to descend and very few weeds other than withered blue grass. Wherever there were succulent weeds under infected trees many larvæ fed and pupated in these.

None of the species of moth fly around in the day, unless disturbed, and then with a rapid zigzag motion they fly down into the grass to hide. Owing to the distance ($2\frac{1}{2}$ miles) of the orchard from our boarding places and the fact that the moths did not lay during the day time so far as we could tell, we did not see any of them ovipositing but know that the eggs outside are laid within a few days after the emergence of the adult, just as they are in the cages.

There is clearly only one brood a year of the Fruit-tree Leaf-roller and of the Box-elder Leaf-roller respectively, but there are two broods of the Oblique-

banded species. The eggs of this last species, laid in the cages, began to hatch in seven days after they were laid. The young larvæ once they began to emerge out of the mass did so in a very short period and were seen to be very active from the moment of emergence. They were placed upon succulent shoots at the base of a tree and caged in but for some unknown reason died before reaching maturity.

Natural Enemies.

1. Spiders, ants, syrphid-fly larvæ and pentatomids each destroyed some larvæ but not a large number compared with the total.

2. A number of instances were observed where very active Leaf-roller larvæ devoured their more sluggish brothers, the sluggishness being due either to disease or preparations for moulting or pupation.

3. Birds feed to some extent upon them, but there were very few birds in the Johnson orchard.

4. Disease almost all through the larval season destroyed a considerable number, especially towards the end of the season. Pupæ, too, were evidently diseased for many were found that shrivelled up and turned black. Some of these had been parasitized but many had not. The dead larvæ were not killed by spraying as they were found also on unsprayed trees.

5. Tachinid parasites were present in moderate numbers. There were two species of these: *Masicera eufitchiæ,* Townsend, and *Exorista cæsar,* Aldrich, n. sp. The latter were far the more numerous. (Dr. J. M. Aldrich kindly indentified the Tachinidæ for me.)

6. At least two and possibly three species of Ichneumons were common but we have not yet been able to get them determined.

Apparently not more than 5 per cent. of the larvæ were destroyed by parasites. They would probably have been much more abundant if the weather had been warmer. The month of June was very cold and on cold days parasites scarcely appeared at all. Disease evidently played a greater part in control than parasites.

For some reason more than half of the eggs of the first brood moths of *rosaceana* failed to hatch though the larvæ could be seen very plainly inside, but, as stated above, we found only four egg masses of this species.

Methods of Control.

We, probably like everyone else who has examined the work of *Tortrix (Cacœcia) argyrospila,* found it hard to believe that a caterpillar that left the leaves in such an eaten, ragged condition could not be satisfactorily combated with arsenical sprays but our experience this year leads us to agree with Herrick, Childs and several others that arsenical sprays are not satisfactory. They kill a considerable number but not nearly enough to prevent great loss. There are two reasons for the failure of these poisons to be effective:—(1) While the larvæ are still small and will die if they eat the poison, their habits of feeding prevent the great majority of them from getting access to it. This is because as soon as they hatch they usually seek an opening bud or leaf just beginning to unfold itself, and work into the centre of these, feeding in the interior and therefore unpoisoned part, and retarding for a considerable time the opening. On Spy trees, at least, unfolded leaves suitable for the later hatching larvæ to hide in are present until the blossoms are

wide open, and are sought by the majority of the young larvæ in preference to open leaves. The undeveloped fruit buds are also sought. (2) When the larvæ become large they seem to be very little affected by the poison. We found many well poisoned leaves being eaten and the larvæ perfectly healthy.

That the poison will kill the younger larvæ if they eat it was proved by Mr. Crawford by immersing infested twigs in various strengths of arsenate of lead in water. He used 2, 3, 4 and 5 lbs. to 40 gals. of water respectively, and killed all larvæ with each strength except those in the undeveloped leaves that were so closely folded that the liquid did not get in. It entered all loosely rolled leaves. This sort of dipping, however, is very different from the very best spraying even with power machines that can be done, especially on large trees, because the spray fails to get into many a loosely rolled leaf, or mass of blossom clusters or leaves webbed together.

Unfortunately, I was too busy conducting spraying experiments for San José Scale, Canker Worms, Codling Moth and Apple Scab in an orchard in the Niagara district to do the spraying myself at Simcoe, and Mr. Crawford was too busy watching the three Leaf-rollers and the Capsid to devote much of his time to it. Mr. Johnson, however, had a good outfit and certainly sprayed more thoroughly than most men would do. He was just as eager to kill these insects as we were. Four applications with double strength arsenate of lead (almost 4 lbs. to 40 gals. of dilute lime-sulphur) were used. The first was just as the leaflets began to appear, the second just before the blossoms opened, the third as soon as the blossoms fell, and the last two weeks later. Black-leaf-40 was used at his own desire with the last of these to destroy Aphids. The foliage showed whitish all summer long with these heavy sprayings.

Mr. Sexsmith, of Trenton, on my advice also sprayed his orchard very heavily before the blossoms opened and used double strength arsenate of lead. He also sprayed heavily for the Codling Moth. Yet in both orchards the results were very disappointing for there were numerous larvæ left and many observations in the former by Mr. Crawford and myself convinced us that only a small percentage of the larvæ had been poisoned. I intend, however, to re-test this next year and supervise all the spraying myself.

Black-Leaf-40, it is claimed by some, will control this pest if applied while they are young. Gill, of Washington Bureau, tested this but did not get so good results as from arsenate of lead alone. It certainly had no lasting effect upon the medium sized larvæ at Simcoe, though for a little while it seemed to stupify some of them. It doubtless would help in the spray just before the blossoms burst, but would not kill the larvæ in the closely folded leaves and buds. It seems to me we could not possibly hope to get satisfactory results from it even with two applications. It is, moreover, very costly.

Lime-sulphur is known to be useless against the eggs.

Miscible oils alone have given really satisfactory results to most investigators. This spray is used only against the eggs.

I sent Mr. Johnson ten gallons of Scalecide and instructed him to dilute this 1 to 5 and to spray just as the buds were ready to burst. He was told to centre his spraying on the twigs of the infested Spys and pay no attention to the bare branches and trunk. He did so and used about from 4 to 5 gals. to a tree One Baldwin tree he sprayed heavily. The result was that this tree showed approximately 80 per cent. of unhatched eggs, unsprayed trees only about 2 per cent., and the lightly sprayed Spy trees not more than from 10 to 25 per cent. The explanation, however, of the poor result is simple but very instructive.

Scalecide will not kill the eggs unless they are thoroughly wet and 4 *to 5 gallons per tree was not more than half enough to wet all the twigs on these large 40-year-old Spy trees.* It only allowed for a fine mist. Both he and I were afraid to risk heavy spraying with a miscible oil without further experience with it. I also observed that on large Spy trees with their tendency for upright twigs and branches the same care would be necessary to do thorough work as if one were spraying for San José Scale, otherwise numerous twigs at the farther side of a tree would have only one side of their bark wet because of the failure of the spray to reach through that far. Most reported experiments with miscible oils have been done on trees 12 to 14 years of age, but these are vastly easier to spray thoroughly than trees twice or three times their size. A strong wind would help greatly in this spraying. Also well pruned trees would be a great boon. Mr. Johnson's, however, were very well pruned.

Scalecide and another as yet unnamed miscible oil, and also Caustic Soda solution, were tested this August on egg masses, and though used very strong, have had no effect upon the eggs of either *argyrosphila* or *semiferana,* so that fall spraying appears to be useless.

Recommendations.

From the experience gained this year, we feel like recommending the following methods of control:

1. Prune trees well, thinning out the excessive branches and twigs and lowering the trees where possible. This is to make spraying easier, cheaper and more effective.

2. Spray very thoroughly with Scalecide or some other good miscible oil, just as the leaf-buds are almost ready to burst but so as to finish before they have done so. Take care to wet well the top and both sides of all the twigs. There are scarcely any eggs on the underside of twigs or on any large branch at least in Ontario.

3. Use 3 to 4 lbs. arsenate of lead to 40 gals. of dilute lime-sulphur or Bordeaux mixture in the application just before the blossoms burst, and drench the foliage, covering even the underside of the leaves.

4. Spray again heavily for Codling Moth with 3 instead of 2 lbs. arsenate of lead.

Note.—If Scalecide or other good miscible oil is considered too expensive or cannot be secured, add Black-Leaf-40 or some equally strong tobacco extract to the spray before the blossoms burst, using a little stronger than for Aphids, and using lime-sulphur, not Bordeaux, with it.

5. If the fruit grower has many chickens and can establish these in the orchard, they will destroy great numbers of larvæ and pupæ whether the orchard is cultivated or not.

6. Cultivation up to as late as safe for the district, with moderately deep discing the last time, should help to destroy many larvæ and pupæ that reach the ground or that are feeding on the weeds that may spring up from time to time. Adults from pupæ buried 2 inches deep by Mr. Crawford were found by him to be unable to emerge.

Mr. Winn: I am sure you have all enjoyed Professor Caesar's paper.

Prof. Caesar: As to dust sprays for Leaf-rollers, I should say that there is some reason to believe that the dust spray would enter better into the places where these little larvæ are concealed than the liquid spray.

Mr. Treherne: May I ask a question? Have you tested the effect of sprays like Bordeaux and lime-sulphur in relation to the oil coating on trees?

Prof. Caesar: We could not make any definite statements in this connection.

Mr. Sanders: Did you find any variation in the color of the heads of *Archips rosaceana?*

Prof. Caesar: I may say that we laboured under difficulties as at first we did not know which larvæ were which. I am not sure how much variation there was. This species was rare in the orchard.

Mr. Petch: In regard to this new pest in the Province of Quebec for three years out of the last four we have not had them at all. Last year they appeared and attacked 75 per cent. of the fruit in some orchards; this year in the very same orchards after the ordinary spraying there was no injury. We have both species that were mentioned. It seems to me that this pest has, through some climatic conditions or through some assistance, come over to our fruit land and, through some other means which I do not know, disappeared. Previously I do not know that it has been recorded in the Province of Quebec as a serious pest.

Mr. Winn: I think there is some doubt as to where that species came from.

Prof. Caesar: I would like to say that there is little doubt that this insect will come under control within a few years.

Mr. Winn: There are fifteen minutes left to be devoted to questions that may be asked. The meeting is open for general discussion.

Mr. Treherne: I would like to start the discussion by asking for some information on the latest sprays, like Soluble Sulphur, Blackleaf 40, and the different kinds of oil sprays.

Mr. Sanders: We had very much experience with Soluble Sulphur this year, but we are not in a position to make any recommendations on this material, although some day we may be able to make a spray of it.

Dr. Fernald: I have had a little experience with soluble sulphur and I may say that under the conditions in which I used it it did did not prove a good poison. Some experiments made years ago and not published until after they had long been duplicated, beginning first with the analysis of the lime sulphur and determinations of the ingredients found in it, show conclusively that the results at that time under those circumstances were obtained with polysulphids and thiosulphate, and that when these reduced to sulphite we got absolutely no results whatever. I have some hope, however, for soluble sulphur, though I may have nothing whatever to base my hope on after all. It is, perhaps, among the possibilities that the Red Spider may yet prove to be more or less successfully attacked by such a substance as soluble sulphur. It is one of the things that I hope yet to carry on experiments with. I can only say, therefore, that I am hoping there is something in it, and yet I do not know.

Mr. Sanders: Did you ever have any experience with Barium sulphide.

Dr. Fernald: Yes. We tried it this year and watched the results carefully all summer on San José Scale. The results have been quite satisfactory. The same trees which a year ago last spring were treated with the lime sulphur, and this year with Barium sulphide, were on the whole in better condition than they were a year ago. That does not mean, you will realize, that the treatment was distinctly better than lime sulphur, because there might have been other factors this summer which did not appear a year ago, but if we can get anything like the same results we found it a much more convenient substance to handle. It is much more easily shipped.

MR. PETCH: I would like to say from our experience in Quebec, although small, that the use of these various spray mixtures ought to depend upon the insects which we have to control. For instance, we know that ordinary lime sulphur will largely control the Tent Caterpillar if sprayed at the proper time, and when we used a soluble sulphur we had absolutely no results at all in controlling the Tent Caterpillar. Furthermore, this year I have used arsenite of lime, one quart to forty gallons, and there has been absolutely no injury to the foliage. It was combined with Bordeaux mixture.

MR. SANDERS: The arsenite of lime we used burned the foliage very badly in almost every case.

PROF. CAESAR: As for Soluble Sulphur, I may say we tested this mixture on old, badly infested apple orchards two years ago in the Niagara district and again this year, and found it gave very good satisfaction against San José Scale, just as good as lime sulphur or Scalecide. We have not tested Barium sulphide because the company could not supply us with it. We have also obtained good results from soluble sulphur as a summer spray, but found it, when used with arsenate of lead, more inclined to burn than the lime sulphur.

Arsenite of lime with lime sulphur is a decidedly dangerous spray to use. I have burned nearly every leaf off trees with it, but there are some people who still use it and get very little burning. When used with Bordeaux mixture it is usually safe. It is particularly good for spraying potatoes used along with Bordeaux.

The matter of injury from sprays to apple foliage depends to a great extent upon moisture condition. If the spray, particularly lime sulphur, dries quickly after being applied there is usually no burning, but if it remains in a liquid state on the leaves for some considerable time due to fog or rain, it may do a good deal of burning.

MR. SANDERS: I think that has been the experience all over the country this year; it has become a question of moisture.

MR. WINN: I will ask Dr. Hewitt to make a few remarks about the smoker.

PROF. LOCHHEAD: Before adjourning, I have much pleasure in rising to move a vote of thanks to our retiring President. I have observed him for the last three years, and during that time Dr. Hewitt has presided over our deliberations and carried the meetings through to a most successful conclusion. For the last two years he has been President by right of choice and he has brought the society to a most flourishing condition. Last year we had a most enjoyable meeting in Toronto, and this year it has been still better. I think all will agree that our proceedings have been most excellent. I would like also to include in my motion the thanks of the society to our visitors. We are very much indebted to Professor Fernald and Mr. Burgess for coming up to Canada, and we are also extremely pleased to have Mr. Lounsbury, of South Africa, with us. They are all distinguished visitors, and they have been helping us out wonderfully. I know that the society will show their appreciation in a fitting manner.

PROF. CAESAR: There is not one of us here but endorses what Professor Lochhead has just said. Dr. Hewitt has certainly done wonders for the Society the last few years. Of course, behind Dr. Hewitt has been Mr. Gibson and the other members at Ottawa. It is really a great pleasure and a great source of benefit to be able in the discussions we have had to call upon those who have come from outside, and we have had a broader view of entomology and a greater amount of benefit from the presence of these men.

Mr. Gibson: I would like to move a vote of thanks to Dr. F. J. White, the Principal of the Normal School, for allowing us the use of the Assembly Hall last evening.

Mr. Tothill: In rising to second this motion I may say that this has been one of the most enjoyable meetings of this organization.

A PRELIMINARY LIST OF PARASITIC INSECTS KNOWN TO OCCUR IN CANADA.

R. C. Treherne, Field Officer, Entomological Branch, Department of Agriculture, Ottawa.

The following list of parasitic insects of some of the more common pests is presented to guide entomologists in Canada in the numbers and names of parasites recorded in Canada. This list does not claim to include all known parasitic insects recorded in Canada, but it is hoped that as times goes on it may be supplemented by additional data and become a more complete guide for reference.

In preparing this present list the following literature has been consulted:—

(1) The Reports of the Ontario Entomological Society, 1870-1914.

(2) The Reports of the Dominion Entomologist in the Experimental Farms Reports and separate Reports of the Department of Agriculture of Canada, 1884-1914.

(3) The Bulletins of the Division of Entomology and the Entomological Branch of the Dominion Department of Agriculture until the close of March, 1915.

(4) The Annual Reports of the Department of Agriculture, Ontario, 1880-1913.

(5) The various Agricultural and Entomological publications from Nova Scotia, New Brunswick, Quebec, and British Columbia, until the close of 1914.

(6) The Annual Reports of the Quebec Society for the Protection of Plants, 1909-1914.

An occasional reference is made to *The Canadian Entomologist,* but no effort has been made to include the many valuable records incorporated within the pages of this journal. This will be done on a later occasion. The same applies to the Proceedings of the United States National Museum, and other publications issued in the United States, in which many original records of parasites named from Canadian material may be found.

As a general rule I have recorded in the following list only the names of parasitic insects mentioned as definitely determined species, and further so as far as possible, only records in which the host and its parasite or parasites are clearly shown to be associated and to occur in Canada.

Alsophila pometaria Harris. The Fall Canker Worm.

Apanteles palæacritæ Ril.

Braconid.. *Report* XXIV., Ent. Soc. Ont., 1893, p. 25. Harrington, On larva. Ottawa, Ontario.

Hemiteles sessilis (Gmel) Grav. (?secondary).

Ichneumon. Rpt. XXIV., Ent. Soc. Ont., 1893, p. 25. Harrington. On larva. Ottawa, Ont.

Ambesa walsinghami Rag. The Hickory Leaf Roller.
MESOSTENUS THORACICUS Cress.
Ichneumon. Rpt. XXIV., Ent. Soc. Ont., 1893, p. 25. Harrington. On larva. Ottawa, Ont.

Ampelophaga myron Cram. The Lesser Grape Vine Sphinx.
APANTELES CONGREGATUS (Say) Prov.
Braconid. Rpt. Dom. Ent., Cen. Exp. Farm, Canada, 1892, p. 161. Fletcher. Ex pupa; generally distributed over Western Ontario.

Anosia plexippus Linn. The Monarch.
TRICHOGRAMMA MINUTUM Ril.
Chalcid. Rpt. XXI., Ent. Soc. Ont., 1890, p. 72. Harrington, Ottawa, Ont. On egg.

Apatela hastulifera A. and S.
RHOGAS INTERMEDIUS Cress.
Braconid. Rpt. XXV., Ent. Soc. Ont., 1894, p. 55. Fyles. Ontario. On larva.

Aphids.
See Macrosiphum, Aphis.

Aphis (Siphocorynæ) avenæ Fab. The European Grain Aphis.
APHIDIUS OBSCURIPES Ashm.
Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1895, p. 137. Fletcher, Muskoka, Ont.

Aphis brassicæ L. The Cabbage Aphis.
LIPOLEXIS (APHIDIUS) RAPÆ Curtis.
Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, 1904, p. 228. Fletcher, Ottawa, Ont.

Aphis—on Raspberry.
LYGOCERUS STIGMATUS (Say) Ashm.
Proctotrupid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1887, p. 36. Fletcher, Ottawa, Ont.

Apina.
See Bees, Megachile.

Argyresthia thuiella Pac. The White Cedar Twig Borer.
PENTACHNEMUS BUCCULATRICIS How.
Chalcid. Rpt. Dom. Ent. Cent. Exp. Farm, Canada, 1906, p. 231. Fletcher, Ottawa, Ont.
DEROSTENES TRIFASCIATUS Ashm.
Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1906, p. 231. Fletcher, Ottawa, Ont.

Asparagus Beetle.
See Crioceris.

Army Worm.
See Cirphis.

Aspidiotus ostræformis Curtis. The European Fruit Scale.
APHELINUS MYTILASPIDIS Baron.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Aspidiotus perniciosus Coms. The San José Scale.
APHELINUS FUSCIPENNIS How.
Chalcid. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 53. Jarvis, Ontario. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

APHELINUS MYTILASPIDIS Baron.
Chalcid. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 53. Jarvis, Ontario.
Rpt. XLI., Ont. Ent. Soc., 1910, p. 74. Eastham, Guelph, Ont.

Aster Gall Moth.
See Gelechia.

Aulacaspis rosæ Bouche. The Rose Scale.
APHELINUS DIASPIDIS How.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Bassus albosignatus Grav. See Syrphus ribesii.
ASAPHES VULGARIS Walk.
Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 172.
Fletcher, Ottawa, Ont.

Bees.
FOENUS INCERTUS Cress.
FOENUS TARSATORIUS Say.
Evaniids. Faune Ent. Canada, 1883, p. 246. Provancher, Quebec.
Rpt. XXI., Ent. Soc. Ont., 1890, p. 66. Harrington, Ontario.
LEUCOSPIS AFFINIS Say.
Chalcid. Rpt. XXI., Ent. Soc. Ont., 1890, p. 71. Harrington, Ontario.

Birch Sawfly.
See Hylotoma.

Blackberry Scale.
See Eulecanium.

Brown-tail Moth.
See Euproctis.

Bud Moth.
See Tmetocera.

Cabbage Aphis.
See Aphis brassicæ.

Cabbage Root Maggot.
See Phorbia.

Cabbage White Butterfly.
See Pontia.

Cecropia Moth.
See Samia.

Cedar Twig Borer.
See Argyresthia.

Celery Caterpillar.
See Papilio.

Cigar Case Bearer.
See Coleophora.

Chionaspis furfura Fitch. The Scurfy Scale.
ABLERUS CLISIOCAMPÆ (Ashm) How.
Chalcid. Rpt. XXXVIII., Ent. Soc. Ont., 1907, p. 71. Jarvis, Ontario.
Rpt. XLI., Ent. Soc. Ont., 1910, p. 75. Eastham, Guelph, Ont.

Chionaspis pinifoliæ Fitch. The Pine Leaf Scale.
APHELINUS MYTILASPIDIS Baron.
Chalcid. Rpt. XLI., Ent. Soc. Ont., 1910, p. 74. Eastham, Guelph, Ont.
PHYSCUS VARIICORNIS How.
Chalcid. Rpt. XLI., Ent. Soc. Ont., 1910, p. 75. Eastham, Guelph, Ont.

Chionaspis salicis Linn. The Willow Scale.

APHELINUS MYTILASPIDIS Baron.

Chalcid. Rpt. XLI., Ent. Soc. Ont., 1910, p. 74. Eastham, Guelph, Ont.

Cimbex americana Leach. The Willow Sawfly.

OPHELTES GLAUCOPTERUS (L) Holmgr.

Ichneumon. Faune, Ent. Canada, 1883, p. 350. Provancher, Quebec.
Can. Ent. XIX., 1887, p. 80. Fletcher, Ottawa, Ont. On pupa.
5th Ann. Rpt. Quebec Society Protection of Plants, 1912-1913, p. 28. Fyles.

Cirphis (Leucania) unipuncta How. The Army Worm.

OPHION PURGATUS Say.

Ichneumon. Faune. Ent. Canada, 1883, p. 351. Provancher, Que.
Rpt. XXI., Ent. Soc. Ont., 1890, p. 67. Harrington, Ontario.
Rpt. XXVII., Ent. Soc. Ont., 1896, p. 51. Panton. Generally distributed in Ontario.

ICHNEUMON LEUCANIÆ Fitch.

Ichneumon. Rpt. XXVII., Ent. Soc. Ont., 1896, p. 51. Panton, Ontario. Generally distributed.

PANISCUS GEMINATUS Say.

Guelph, Ont. Treesbank, Man.

PIMPLIDEA PEDALIS (Cress).

Nova Scotia.

ICHNEUMON CANADENSIS Cr.

Ontario. Nova Scotia.

ICHNEUMON LÆTUS Br.

Nova Scotia. New Brunswick.

ICHNEUMON JUCUNDUS Br.

Guelph, Ont.

Ichneumons. Bull. 9, Ent. Branch Dom. Can. Dept. Agr., 1915. Gibson.

APANTELES MILITARIS Walsh. (Ontario.)

APANTELES LIMENTIDIS Riley. (Nova Scotia.)

METEORUS COMMUNIS Cr. (Ontario.)

Braconids. Bull, 9, Ent. Branch, Dom. Can. Dept. Agr., 1915. Gibson, Ont.

WAGNERIA (PHORICHÆTA) SEQUAX Will.

Tachinid. Bull. 9, Ent. Branch Dom. Can. Dept. Agr., 1915. Gibson, Guelph, Ont.

EXORISTA FLAVICAUDA Ril.

Tachinid. Rpt. Dom. Ent. Cen. Exp. Farm, 1896, p. 238. Fletcher, Ontario.

NEMOREA LEUCANIÆ Kirkp.

Tachinid. Rpt. XXVII., Ent. Soc. Ont., 1896, p. 102. Fyles, Levis, Que.

WINTHEMIA QUADRIPUSTULATA Fab.

Tachinid. Bull. 9, Ent. Branch, Dom. Can. Dept. Agr., 1915. Gibson, Ontario; Nova Scotia.

PHOROCERA (EUPHOROCERA) CLARIPENNIS Macq.

Tachinid. Bull. 9, Ent. Branch, Dom. Can. Dept. Agr., 1915. Gibson, Guelph, Ont.

PHRYXE (EXORISTA) VULGARIS Fall.

Tachinid. Bull. 9, Ent. Branch, Dom. Can. Dept. Agr., 1915. Gibson. New Brunswick. Nova Scotia.

Coccotorus scutellaris Le Conte. The Plum Gouger.

SIGALPHUS CANADENSIS Prov.

Braconid. Faune. Ent. Canada, 1883, p. 530. Provancher, Que. Can. Ent. XXII., 1890, p. 115. Gillette.

Coccus hesperidum Linn. The Soft Scale.

COCCOPHAGUS COGNATUS How.

Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Codling Moth.

See Cydia.

Coleophora fletcherella Fernald. The Cigar Case Bearer.

MICRODUS LATICINCTUS Ash.

Braconid. Rpt. XXVII., Ont. Ent. Soc., 1896, p. 67. Fletcher, Port Hope, Ont.

Colias philodice Godt. The Clouded Sulphur.

MEGORISMUS NUBILIPENNIS Ashm.

Ichneumon. Rpt. Ent. Cen. Exp. Farm, Canada, 1887, p. 18. Fletcher, on larva, Ottawa, Ontario.

Conotrachelus nenuphar Herbst. Plum Curculia.

THERSILOCHUS CONOTRACHELI Ril.?

Ichneumon. Rpt. XXI. 1890, p. 67. Ont. Ent. Soc. Harrington, Ont.

Cottony Maple Scale.

See Pulvinaria.

Crioceris asparagi L. The Asparagus Beetle.

TETRASTICHUS ASPARAGI Cwfd.

Chalcid. Agricultural Gazette, Canada, November, 1915, p. 1055. Ross, on egg, Vineland, Ont.

Currant Sawfly.

See Pteronus.

Cutworm.

See Hadena, Mamestra, Noctua, Peridroma.

Cydia pomonella Linn. The Codling Moth.

PIMPLA PTERELAS (Say) Walsh.

Ichneumon. Rpt. XXXVII. Ent. Soc. Ont., 1906, p. 5. Brodie, Freeman, Ont.

EPHIALTES sp.

Ichneumon. Rpt. XXXVII. Ent. Soc. Ont., 1906, p. 5. Brodie, Prescott, Ont.

Diamond Back Moth.

See Plutella.

Dog-wood Sawfly.

See Harpiphorus.

Eriopeltis festucæ Fonse. The Grass Scale.

LEUCOPSIS BELULILA.

Dipterous. Rpt. XLI., Ent. Soc. Ont., 1910, p. 76. Jarvis, Nova Scotia.

Eulecanium caryæ Fitch.

CHILONEURUS ALBICORNIS How.

Chalcid. Rpt. XLI., Ent. Soc. Ont., 1910, p. 75. Eastham, Guelph, Ont.

Eucomys scutellata (Swed.) D. T.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Ageniaspis fuscicollis (Dalm) Thoms.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Eulecanium cerasifex Fitch. The New York Plum Scale.
Pachyneuron altiscota How.
Chalcid. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 65. Jarvis, Ont.
Eunotus lividus Ashm.
Chalcid. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 65. Jarvis, Ont.
Chiloneurus albicornis How.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Eucomys fusca (How.) D. T.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Coccophagus lecanii Smith.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Coccophagus flavoscutellum Ashm.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Coccophagus cognatus How.
Chalcid. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 65. Jarvis Ont.
Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Ageniaspis fuscicollis (Dalm.) Thoms.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Aphycus pulvinariæ How.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Aphycus johnsoni.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
Aphycus flaviceps.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Jarvis, Guelph, Ont.
Blastothrix longipennis How.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Eulecanium fitchii Sign. The Blackberry Soft Scale.
Encyrtus fuscus How.
Aphycus annulipes (Ashm) How. (Chalcids.)
Coccophagus flavoscutellum Ashm.
Eutochus xanthothorax Ash. (Proctotrupid.)
Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1901, p. 241. Fletcher, Trenton, Ont.

Eulecanium fletcheri Ckll.
Coccophagus lecanii Smith.
Coccophagus cognatus How.
Coccophagus fletcheri How.

Comys bicolor How.
Chiloneurus albicornis How.
Aphycus jarvisi How.
Aphycus pulvinariæ How.
Blastothrix longipennis How.
Chalcids. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Euproctis chrysorrhoea L. The Brown Tail Moth.
Pentarthrum minutum Ril.
Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, 1911, p. 217. Hewitt, St. Stephen, New Brunswick.
Apanteles lacteicolor Vier.
Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1914. p. 860. Hewitt, Bear River, Nova Scotia.
Compsilura concinnata Meig.
Tachinid. Rpt. XLIII., Ont. Ent. Soc., 1912, p. 57. Tothill, Fredericton, New Brunswick.
Phorocera leucaniæ Cog.
Tachinid. Rpt. XLIII., Ont. Ent. Soc., 1912, p. 58. Tothill, Charlotte County, New Brunswick.

Euthisanotia grata Fab. The Beautiful Wood Nymph.
Exorista leucania.
Tachinid. Rpt. I., Ont. Ent. Soc., 1870, p. 99. Saunders, Ont.

Fall Canker Worm.
See Alsophila pometaria.

Fall Webworm.
See Hyphantria.

Gelechia gallæasteriella Kell. The White Aster Gall Moth.
Bracon furtivus Fyles.
Braconid. Can. Ent. XXIV., 1892, p. 34. Fyles, South Quebec, Que.
Pimpla pterelas (Say) Walsh.
Ichneumon. Can. Ent. XXIV., 1892, p. 35. Fyles, South Quebec, Que.
Trychosis tunicula-rubra Fyles.
Ichneumon. Rpt. XXXIV., Ent. Soc. Ont., 1903, p. 73. Fyles, Levis, Que.

Grain Aphids.
See Aphis avenæ.

Grapta satyrus Edw. Polygonia satyrus Edw.
Ichneumon caliginosus Cress.
Ichneumon. Entomological Record, Ont. Ent. Soc., 1907, p. 16. Gibson. Ex pupa. Kaslo, B.C.; Ottawa, Ont.
Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 128. Fletcher. Ex pupa. Ottawa, Ont.

Grapevine Sphinx.
See Amphelophaga.

Grass Scale.
See Eriopeltis.

Hadena devastatrix Brace. Glassy Cutworm.
Berecyntus bakeri How. Var.
Chalcid. Bull. 10, Ent. Branch, Dom. Can. Dept. Agri., 1915. Gibson, Ottawa, Ont.

Halisidota maculata Harr.
Ichneumon. THERONIA MELANOCEPHALA (Brulle) Prov.
Rpt. XXI., Ont. Ent. Soc., 1890, p. 69. Harrington, Ottawa, Ont.
PIMPLA PEDALIS Cress.
Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1908, p. 209. Fletcher, Eastern Canada.
Harmologa.
See Tortrix.
Harpiphorus tarsatus (Say) Nort. The Dog-wood Sawfly.
HEMITELES MUCRONATUS Prov.
Ichneumon. Rpt. XXX., Ont. Ent. Soc., 1899, p. 104. Fyles, Levis, Que.
Hemerocampa leucostigma S. and A. The White Marked Tussock Moth.
PIMPLA INQUISITORIELLA D.T. Recorded as Inquisitor.
Ichneumon. Rpt. XXVII., Ont. Ent. Soc., 1896, p. 53. Panton, Toronto, Ont.
DIGLOCHIS OMNIVORA Walk.
Chalcid. Rpt. XXXVI., Ont. Ent. Soc., 1905, p. 19. Lyman, Montreal, Que.
Hessian Fly.
See Phytophaga.
Heterocampa manteo Dbl.
OPHION BILINEATUS Say.
Ichneumon. Rpt. XXXIV., Ont. Ent. Soc., 1903, p. 58. Gibson, Meach Lake, Que. On larva.
Hickory Leaf Roller.
See Ambesa Walsinghami Rag.
Hop Vine Borer.
See Hydroecia.
Hylotoma pectoralis Leach. The White Birch Sawfly.
PIMPLA INQUISITORIELLA D.T. (Recorded as Inquisitor.)
Ichneumon. Rpt. XXX., Ont. Ent. Soc., 1899, p. 104. Fyles, Levis, Que.
5th Annual Rpt. Quebec Society for Protection of Plants, 1912-1913, p. 30. Fyles, Quebec.
Hyphantria cunea Dru. Fall Webworm.
LIMNERIUM VALIDUM Cress.
LIMNERIUM PILOSOTUM Cr.
EXOCHILUM MUNDUM Say.
Ichneumons. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1914, p. 861. Hewitt, New Brunswick.
COMPSILURA CONCINNATA Meig.
Tachinid. Rpt. XLIII., Ont. Ent. Soc., 1912, p. 57. Tothill, on larva. Fredericton, New Brunswick.
Hydræcia immanis Guen. Hop Vine Borer.
ICHNEUMON JUCUNDUS Brulle.
Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, 1892, p. 150. Fletcher, Bethel, Ont.
Iris Pod Weevil.
See Mononychus.

Isosoma tritici Fitch. The Wheat Joint Worm.

HOMOPORUS CHALCIDIPHAGUS Walsh.

EUPELMUS EPICASTE Walk.

Chalcid. Rpt. XXIX., Ont. Ent. Soc., 1898, p. 77. Fletcher, Verdun, Ont.

Kermes pubescens Bogue.

APHYCUS PULCHELLUS How.

BLASTOTHRIX LONGIPENNIS How.

Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Larch Sawfly.

See Nematus.

Lecanium Scale (Soft Scale).

See Coccus.

Lepidosaphes ulmi Linn. The Oyster Shell Scale.

APHELINUS MYTILASPIDIS Baron.

Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1903, p. 188. Fletcher, generally distributed in South Western Ontario.

Rpt. Dominion Entomologist, 1887, p. 31, British Columbia.

Rpt. Dominion Entomologist, 1903, p. 188, universally distributed.

Rpt. Dom. Ent. Exp. Farm, Canada, 1887, p. 31. Fletcher, New Westminster, B.C.

Lyctus unipunctatus Herbert.—linearis. The Powder Post Beetle.

HECABALUS LYCTI Cress.

HECABALUS UTILIS Cress.

Braconid. Rpt. XXXII., Ont. Ent. Soc., 1901, p. 108. Fletcher, Ottawa, Ont.

Macrosiphum granaria Buckton. Grain Aphis.

APHIDIUS GRANARIAPHIS Cook.

Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1898, p. 179. Fletcher, Ont.

Can. Ent. Vol. XXIV., 1890, p. 125.

LYSIPHLEBUS TRITICI Ashm.

Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1908, p. 194. Fletcher, Ontario.

APHIDIUS AVENÆ Fitch.

Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1903, p. 171. Fletcher, Ottawa, Ont.

ASAPHES VULGARIS Walk.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1903, p. 171. Fletcher, Ottawa, Ont.

LYGOCERUS NIGER How.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1903, p. 171. Fletcher, Ottawa, Ont.

ALLOTRIA TRITICI Fitch.

Cynipid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1903, p. 171. Fletcher, Ottawa, Ont.

Macrosiphum pisi Kalt. The Pea Aphis.

TRIOXYS (PRAON) CERASAPHIS Fitch.

APHIDIUS FLETCHERI Ash.

Braconid. Rpt. XXX., Ont. Ent. Soc., 1899, p. 107. Fletcher, Ottawa, Ont.

Rpt. Dom. Ent. Cen. Exp. Farm, 1899, p. 172. Fletcher, Ottawa, Ont.

MEGORISMUS FLETCHERI Crawford.

Chalcid. Rpt. XL., Ont. Ent. Soc., 1909, p. 14. Gibson, Ottawa, Ont.

Malacosoma disstria Fab. The Forest Tent Caterpillar.

APANTELES LONGICORNIS Prov.

Braconid. Rpt. XXXIV., Ont. Ent. Soc., 1903, p. 73. Fyles, Levis, Que.

PIMPLA CONQUISITOR (Say) Ril.

Ichneumon. Rpt. XXI., Ont. Ent. Soc., 1890, p. 69. Harrington, Ottawa, Ont.

PIMPLA PEDALIS Cress.

Ichneumon. Rpt. XXI., Ont. Ent. Soc., 1890, p. 69. Harrington, Ottawa, Ont.

Mamestra picta Harris. The Zebra Caterpillar.

OPHION PURGATUS Say.

Ichneumon. Can. Ent. XVI., 1884, p. 122. Caulfield, Montreal, Que.

CHAETOSTRICHA (TRICHOGRAMMA) PRETIOSA D.T.

Chalcid. Rpt. XXVII., 1896, Ont. Ent. Soc., p. 64. Fletcher, Ottawa. Ont.

Rpt. Dom. Ent. Cen. Exp. Farm, 1892, p. 161. Fletcher, on egg, Ottawa, Ont.

Mamestra trifolii Rott. Clover Cutworm.

OPHION PURGATUS Say.

Ichneumon. Rpt. XIX., Ont. Ent. Soc., 1888. Fletcher, Ontario, on pupa.

Marumba modesta Harris.—Pachysphinx modesta Harr.

WINTHEMIA QUADRIPUSTULATA Fab.

Tachinid. Entomological Record, Ont. Ent. Soc., 1903, p. 99. Gibson, St. John, New Brunswick.

Megachile brevis Say. Leaf Cutter Bee.

LEUCOSPIS AFFINIS Say.

Chalcid. Rpt. XVII., Ont. Ent. Soc., 1886, p. 52. Guignard, Ottawa, Ontario, on larva.

Megachile centuncularis L. Leaf Cutter Bee.

SEMIOTELLUS CUPREUS Prov.

Chalcid. Rpt. XVII., Ont. Ent. Soc., 1886, p. 52. Guignard. Ottawa, Ont., on larva.

Meromyza americana Fitch. (Causing "Silver Top" in grass.)

COELINIUS MEROMYZÆ Forb.

Braconid. Rpt. XXII., Ont. Ent. Soc., 1891, p. 13. Bethune, Ont.

Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1887, p. 68. Fletcher, Ottawa, Ont.

Monarch Butterfly.

See Anosia.

Monohammus confusor. The Pine Borer.

RHYSSA PERSUASORIA (L.) Grav.

Ichneumon. Faune. Ent. Canada, 1883, p. 418. Provancher, Quebec.

Monohammus scutellatus. The Pine Borer.

RHYSSA PERSUASORIA (L.) Grav.

Ichneumon. Faune. Ent. Canada, 1883, p. 418. Provancher, Que.

Mononychus vulpeculus. The Iris Pod Weevil.

? PIMPLA PTERELAS (Say) Walsh.

Ichneumon. Rpt. XXI., Ont. Ent. Soc., 1890, p. 69. Harrington, Ottawa, Ont.

? PIMPLA INQUISITORIELLA D.T. Recorded as Inquisitor Say.

Ichneumon. Rpt. XLI., Ont. Ent. Soc., 1910, p. 31. Fyles, Hull, Que.

Nematus erichsonii. The Larch Sawfly.

COELOPISTHIA NEMATICIDA Pack.

Chalcid. Bull. 10, 2nd Series, Div. of Ent., Dom. Can., Dept. Agr., Hewitt, on pupa, Ottawa, Ont.

Noctua c-nigrum Linn. The Spotted Cutworm.

EUPLECTRUS FRONTALIS How.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1900, p. 228. Fletcher, Ontario.

Notolophus antiqua Linn. The Rusty Tussock Moth.

TELENOMUS DALMANII (Ratz) Mayr.

Proctotrupid. Rpt. XLI., Ont. Ent. Soc., 1910, Ent. Record, p. 118. Gibson, ex egg, Little Bras d'Or, Cape Breton, N.S.

Oak Looper.

See Therina.

Orgyia sp.

TELENOMUS ORGYIÆ Fitch.

Proctotrupid. Bull. 45, U.S.N.A., p. 53. Ashmead, per Harrington, Ottawa, Ontario, on egg.

Ostræformis Scale.

See Aspidiotus.

Oyster Shell Bark Louse.

See Lepidosaphes.

Papilio eurymedon Boisd.

TROGUS FLETCHERI Harrgt.

Ichneumon. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 128, on pupa, Wellington, B.C. Taylor.

TROGUS FULVIPES Cress.

Ichneumon. Entomological Record, Ont. Ent. Soc., 1907, p. 16. Gibson (Cockle), Kaslo, B.C. Ex pupa.

Pamphila metacomet Harr.

TELENOMUS PAMPHILÆ Ash.

Proctotrupid. Rpt. XXV., Ont. Ent. Soc., 1894, p. 4. Fletcher, Ottawa, Ont.

Papilio polyxenes Fab. The Celery Caterpillar.

TROGUS VULPINUS (Syn. Exesorius).

Ichneumon. Faune. Ent. Canada, 1883, p. 303. Provancher, Que.
Rpt. XXI., Ont. Ent. Soc., 1890, p. 66. Harrington, Ont.

Papilio troilus Linn.

TROGUS FULVIPES Cress.

Ichneumon. Rpt. XL., Ont. Ent. Soc., 1909, p. 82, on pupa. Fyles, Que.

Papilio turnus L.

TROGUS FULVIPES Cress.

Ichneumon. Rpt. XXXVIII., Ont. Ent. Soc., 1907, p. 128, on pupa, Digby, N.S. Aweme, Man. Fletcher.

Entomological Record, Ont. Ent. Soc., 1907, Gibson, Digby, N.S. Aweme, Man.

TRICHOGRAMMA INTERMEDIUM How.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1892, p. 160. Fletcher, on egg, Ottawa, Ont.

Peridroma saucia Hbn. The Variegated Cutworm.

METEORUS VULGARIS Cress.

Braconid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1900, p. 226. Fletcher, Vancouver, B.C.

Phytophaga destructor Say. The Hessian Fly.

MERISUS DESTRUCTOR (Say) Ril.

CHALCID. Rpt. II., Ont. Ent. Soc., 1871, p. 394. Bethune, Ont., on pupa.

Rpt. Dom. Ent. Cen. Exp. Farm. Canada, 1889, p. 63. Fletcher, Thornbury, Ont., and Prince Edward Island.

Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 169. Fletcher, Portage la Prairie, Man.

HOMOPORUS SUBAPTERUS Ril.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1889, p. 63. Fletcher. Thornbury, Ont.

PLATYGASTER sp. (? herricki) Pack.

Proctotrupid. Rpt. II., Ont. Ent. Soc., 1871, p. 394. Bethune, Ont., on egg.

POLYGNOTUS HIEMALIS (Forb.) Ash.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 169. Fletcher, Emerson, Man.

TETRASTICHUS PRODUCTUS Ril.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 169. Fletcher, Prince Edward Island.

ENTEDON? METALLICUS (Nees) Walk.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 169. Fletcher, Prince Edward Island.

EUPELMUS ALLYNII French.

Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 169. Fletcher, Prince Edward Island.

Phorbia (Pegomyia) brassicæ Bouche. The Cabbage Root Maggot.*

TRYBLIOGRAPHA ANTHOMYIÆ.

Cynipid, 5th Annual Rpt. Quebec Society for the Protection of Plants, 1913-1914, p. 41. Du Porte, Macdonald College, Que.

ALEOCHARA ANTHOMYIÆ Sprague.

Staphilinid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1890, p. 164. Fletcher, Ottawa, Ont.

*(NOTE.—Parasites of this insect are under consideration in a bulletin on Root Maggots now in course of preparation in the Entomological Branch, Ottawa, by Gibson and Treherne, January, 1916.)

PACHYCREPOIDEUS DUBIUS Ashm.

Chalcid. Rpt. XLI., Ont. Ent. Soc. Ent. Record, 1910, p. 118. Gibson. ? Puparia, Ottawa, Ont.

Pigeon tremex.

See tremex.

Pine Borer.

See Monohammus.

Pine Leaf Scale.

See Chionaspis.

Plum Scale.

See Eulecanium.

Plum Curculio.

See Conotrachelus.

Plum Gouger.

See Coccotorus.

Plutella maculipennis Curt. The Diamond Back Moth.

LIMNERIUM PARVUM (Prov.) D. T.

Ichneumon. Rpt. XXX., Ont. Ent. Soc., 1899, p. 108. Fletcher, Ottawa, Ont.

Rept. Dom. Ent. Cen. Exp. Farm, Canada, 1890, p. 167. Fletcher. Generally distributed throughout Canada.

PHÆOGENES DISCUS Cress.

Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1890, p. 167. Fletcher, Indian Head, Sask.; Ottawa, Ont.

Polyphemus moth.

See Telea.

Polygonia interrogationis Fab.

PTEROMALUS VANESSÆ Harris.

Ichneumon. Rpt. III., Ont. Ent. Soc., 1872, p. 32. Bethune. Ontario, on pupa.

Pontia rapæ Linn. The Cabbage White.

PTEROMALUS PUPARUM (L) Swed.

Ichneumon. Can. Ent. Nov., 1871, Vol. III., No. 10. Lintner, introduction report.

Rpt. VI., Ont. Ent. Soc., 1875, p. 32. Saunders, Eastern Canada, on pupa.

Rpt. VII., Ont. Ent. Soc., 1876, p. 40. Saunders, London, Ont.

Rpt. VIII., Ont. Ent. Soc., 1877, p. 5. Saunders, review of distribution.

Powder Post Beetle.

See Lyctus.

Protoparce quinquemaculata How. The Tomato Sphinx.

APANTELES CONGREGATUS (Say) Prov.

Braconid. Rpt. XXIV., Ont. Ent. Soc., 1893, p. 27. Harrington, Ont.

Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1892, p. 161. Fletcher, generally distributed over Western Ontario, ex pupa.

Pteronus ribesii Scop. The Imported Currant Worm.

HEMITELES NEMATIVORUS Walsh.

Ichneumon. Can. Ent. Vol. II., No. 2, Oct., 1869, p. 11. Walsh, Ont.

Rpt. II., Ont. Ent. Soc., 1871. Saunders (Bethune), Port Hope, Ont.

CHÆTOSTRICHA (TRICHOGRAMMA) sp. (near pretiosa) Ril.
Chalcid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1892, p. 159. Fletcher, on egg, Arnprior, Ont.

Pulvinaria innumerabilis Rath. The Cottony Maple Scale.
COCCOPHAGUS LECANII Smith.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.
COCCOPHAGUS FLAVOSCUTELLUM Ashm.
Chalcid. Rpt. XLI., Ont. Ent. Soc., 1910, p. 75. Eastham, Guelph, Ont.

Pyrameis cardui. The Painted Lady.
ICHNEUMON RUFIVENTRIS Brulle.
Ichneumon. Rpt. XI., Ont. Ent. Soc., 1881, p. 29. Huestis, St. John, N.B., on larva.

Raspberry aphis.
See Aphis.

Red Humped Apple Tree Caterpillar.
See Schizura.

Rose Scale.
See Aulacaspis.

Rusty Tussock Moth.
See Notolophus.

Samia cecropia Linn. The Cecropia Moth.
CRYPTUS NUNCIUS Say.
Ichneumon. Rpt. XXV., Ont. Ent. Soc., 1894, p. 55. Harrington, Ont., on larva.

San José Scale.
See Aspidiotus.

Schizura concinna S. & A. Red Humped Apple Tree Caterpillar.
OPHION PURGATUS Say.
Ichneumon. Rpt. Dom. Ent. Exp. Farm, Canada, 1887, p. 34. Fletcher, Ont.
LIMNERIUM GUIGNARDII (Prov.) D. T.
Ichneumon. Rpt. Dom. Ent. Exp. Farm, Canada, 1887, p. 34. Fletcher, Ottawa, Ont.
Also Nova Scotia, Rpt. Dom. Ent. 1906, p. 228.

Scolytus (Eccoptogaster) rugulosus Ratz. The Shot Hole Borer.
CHIROPACHYS COLON (L) Westw.
Chalcid. Rpt. XL., Ont. Ent. Soc., 1909, p. 18. Caesar, St. Catharines, Ont.

Scurfy Scale.
See Chionaspis.

Shot Hole Borer.
See Scolytus.

Syrphus ribesii L.
BASSUS ALBOSIGNATUS Grav. (Lœtatorius Fab.)
Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1899, p. 172. Fletcher, Ottawa, Ont.

Telea Polyphemus Cram. The Polyphemus Moth.
CRYPTUS NUNCIUS Say. (Syn. extrematis.)
Ichneumon. Faune. Ent. Canada, Hym. 1883, p. 340. Provancher, Que.

Rpt. XXI., Ont. Ent. Soc., p. 67. Harrington, Ont.

Ophion macrurus (L) Westw. (Syn. macrurum.)

Ichneumon. Faune. Ent. Canada, 1883, p. 350. Provancher. Que.

Rpt. III., Ont. Ent. Soc., 1872, p. 40. Reed, London, Ont.

Rpt. XXI., Ont. Ent. Soc., 1890, p. 67. Harrington, Ottawa. Ont.

Tent Caterpillar.

See Malacosoma.

Therina somniaria Hulst. Vancouver Island Oak Looper.

Ichneumon cestus Cress.

Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada. Fletcher, 1890, p. 177. Victoria, B.C.

Pimpla ellopiæ Harrington.

Ichneumon. Can. Ent. Vol. XXIV., 1892, p. 99. Harrington, Victoria, B.C., ex pupa.

Rpt. Dom. Ent. Cen. Exp. Farm, Canada. Fletcher, 1892, p. 160.

Pimpla Ontario Cress.

Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1904, p. 245. Fletcher, Victoria, B.C.

Pimpla scriptifrons Cress.

Ichneumon. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1905, p. 194. Fletcher, Victoria, B.C.

Telenomus sp.

Proctotrupid. Rpt. Dom. Ent. Cen. Exp. Farm, Canada, 1892, p. 160. Fletcher, on egg, Victoria, B.C.

Tmetocera ocellana Schiff. The Bud Moth.

Pimpla conquisitor (Say) Ril.

Ichneumon. 7th Ann. Rpt. Quebec Society for Protection of Plants, 1914-1915, p. 76. Du Porte, Macdonald College, Que.

Pentarthron minutum Ril. Syn. Trichogramma pretiosa Ril.

Chalcid. 7th Ann. Rpt. Quebec Society for Protection of Plants, 1914-1915. Du Porte, Macdonald College, Que., ex eggs.

Bassus Earinoides Cress.

Ichneumon. 7th Ann. Rpt. Quebec Society for Protection of Plants, 1914-1915. Du Porte, Macdonald College, Que.

Tomato Sphinx.

See Protoparce.

Tortrix (Harmologa) fumiferana. The Spruce Bud-worm.

Pentarthron minitum.

Chalcid. Rpt. XLII., Ont. Ent. Soc., 1911, p. 26. Hewitt, on egg, Ottawa, Ont., Esquimalt, B.C., in Que.

Apanteles, sp.

Braconid. Rpt. XLII., 1911, p. 26. Hewitt, in Quebec and British Columbia.

Apanteles fumiferanæ Viereck.

Braconid. Ent. Rec., 1912, p. 134, Ont. Ent. Soc. Quebec.

Nasonia tortricis Brues.

Rpt. XLI., Ont. Ent. Soc., Gibson, 1910, p. 118, ex pupa, Baskatong. Que.

Tremex Columba Pigeon Tremex.

Megarhyssa lunator (Fabr.) D. T.

Ichneumon. Faune. Ent. Canada, 1883, p. 446. Provancher, Que.

Can. Ent. 1882, p. 82. Harrington, Ottawa, Ont.

MEGARHYSSA ATRATA (Fabr.) D. T.
Ichneumon. Faune. Ent. Canada, 1883, p. 444. Provancher, Que.
Can. Ent. 1882, p. 82. Harrington, Ottawa, Ont.

Trichotaphe levissella Fyles.
HEMITELES MUERONATUS Prov.
Ichneumon. Rpt. XXXIII., Ont. Ent. Soc., 1902, p. 28. Fyles, Que.
LAMPRONOTA MARGINATA Prov.
Ichneumon. Rpt. XXXVIII., Ont. Ent. Soc. Ent. Record, 1907, p. 128. Gibson (Fyles) Levis, Que.

Tussock Moth.
See Hemerocampa.

Vanessa antiopa Linn. Mourning Cloak.
PTEROMALUS PUPARUM (L) Swed.
Ichneumon. Rpt. XXI., Ont. Ent. Soc., 1890, p. 72. Harrington, Ottawa, Ont.

Willow Saw Fly.
See Cimbex.

Willow Scale.
See Chionaspis.

Wheat Joint Worm.
See Isosoma.

Zebra Caterpillar.
See Mamestra.

THE ENTOMOLOGICAL RECORD, 1915.

ARTHUR GIBSON, CHIEF ASSISTANT ENTOMOLOGIST, DEPARTMENT OF AGRICULTURE, OTTAWA.

It is gratifying to be able to state that the collection and study of insects is gradually but surely increasing every year in the different provinces of Canada. This, I think, is largely owing to the fact that economic, or applied, entomology is more and more receiving its due recognition. The importance of local collections of insects to the economic entomologist is indeed of great value, providing, as they do, definite information as to distribution, etc. At Ottawa, as we have previously stated, due provision has been made for a national collection of the insects of Canada, and collectors generally could aid materially in building up this collection by forwarding donations of specimens.

During 1915 much material collected in previous years has been worked over by specialists, in addition to which large collections have been made during the past season in most of the provinces. Many of these are new records for Canada, while the capture of others in certain districts or provinces extend the known range of their distribution.

As in years past we have received invaluable assistance in the determination of many specimens from the recognized authorities in the United States and elsewhere. Our special thanks are due to Dr. L. O. Howard and his associates at Washington—Dr. Dyar, Dr. Banks, Messrs. Schwarz, Crawford, Busck, Rohwer, Gahan and Knab; Sir George F. Hampson, of the British Museum; Prof. H. F. Wickham, of Iowa City, Iowa; Mr. E. P. Van Duzee, of Berkeley, Cal.; Dr. Henry Skinner, of Philadelphia; Col. Thos. L. Casey, of Washington, D.C.; Mr. C. W. Johnson, of Boston, Mass.; Mr. Chas. Liebeck, of Philadelphia, Pa.; Prof. H. S. Hine, of Columbus, Ohio; Dr. J. M. Aldrich, of La Fayette, Ind.; Mr. Chas. W. Leng, of New York, N.Y.; Dr. W. G. Dietz, of Hazleton, Pa.; Dr. F. C. Fall, of Pasadena, Cal.; Mr. M. C. Van Duzee, of Buffalo, N.Y.; Mr. C. A. Frost, of South Framingham, Mass.; Dr. E. C. Van Dyke, of Berkeley, Cal.; Mr. J. R. de la Torre Bueno, of White Plains, N.Y.; Mr. F. H. Wolley-Dod, of Midnapore, Alta., and Dr. E. M. Walker, of Toronto, Ont.

LITERATURE.

Among the books, memoirs, etc., which have appeared during 1915, and which are of interest to Canadian students, the following should be mentioned:

BETHUNE, REV. PROF. C. J. S. Bibliography of Canadian Entomology for the year 1913; Ottawa, Trans. Royal Soc. of Canada, Third Series—1914, Vol. VIII, Section IV, 1914. In this contribution references are given to 151 papers: 42 of these relate to Economic Entomology, 18 to General Entomology, 18 to Lepidoptera, 21 to Diptera, etc.

BANKS, NATHAN. The Acarina or Mites; a review of the group for the use of economic entomologists: United States Department of Agriculture, office of the secretary, Report No. 108. Received December 28th, 1915. This is indeed a very useful contribution of 153 pages. In the introduction information is given on the structure, life-history, classification, etc. Then follows a lengthy discussion on the different families, and many keys are given. Notes on collecting,

preserving and rearing mites are given on pages 141 and 142, and on pages 143-145 a list of works, useful in the study of American Acarina, is given.

Braun, Annette Frances. Evolution of the color pattern in the Microlepidopterous Genus Lithocolletis: Journal of the Academy of Natural Sciences of Philadelphia, Vol. XVI, Second Series, Philadelphia, pp. 105-168, plates III and IV, 26 text figures. A separate of this article (issued February 12th, 1914) has recently been received. Under "Methods and Observations" the author discusses (a) Systematic Position and Characteristics of Lithocolletis, (b) Color Classes Represented and Structure of Scales, (c) Comparative Study of the Adult Markings, (d) Ontogenetic Development of the Color Pattern and (e) Phylogenetic Development of the Color Pattern. The two plates, in colors, at the end of the article well illustrate the various species of the genus. The paper is a most interesting one and undoubtedly of much value.

Brues, Charles T., and Melander, A. L. Key to the Families of North American Insects: published by the authors; Boston, Mass., and Pullman, Wash., 1915, pp. 1-140. As stated by the authors this manual brings together a brief, yet complete, key to the families of American insects, unhampered by more than the explanations needed to make such a tabulation available to the general student. It has been prepared to meet the requirements not alone of college courses in systematic entomology, but also of agricultural high schools and of physicians, fruit inspectors, the modern farmer, the nature lover, or anyone who is concerned with the practical identification of insects. This very useful work will undoubtedly be widely received. 18 full-page plates, illustrating structural characters, etc., are included.

Casey, Thos. L. Memoirs on the Coleoptera, VI; published by the New Era Printing Company, Lancaster, Pa.; issued November 27th, 1915, pp. 1-460. The contents of this the sixth memoir by this well-known coleopterist consists of: Part I, A Review of the American Species of Rutelinæ, Dynastinæ and Cetoniinæ, pp. 1-394; Part II, Studies in some Staphylinid Genera of North America, pp. 395-450. A large number of new species are described, seventeen of which are from Canada.

Fracker, Stanley Black. The Classification of Lepidopterous Larvæ, with ten plates: Illinois Biological Monographs, No. 1, Vol. II, July, 1915; published by the University of Illinois, under the auspices of the Graduate School, Urbana, Ill., pp. 1-169, (contribution No. 43, from the Entomological Laboratory of the University of Illinois). This contribution is divided into two sections, namely, Part one—The Homology of the Setæ, and Part two—Systematic Outline of Families and Genera. The work is a most interesting one. The author in Part One suggests the adoption of Greek letters in place of the Roman numerals now generally used to designate the different tubercles. In the second part, family and generic keys are given, based on larval characters. The plates at the end illustrate arrangement of setæ, etc. This contribution is indeed a valuable one and will doubtless receive much consideration from lepidopterists generally.

Hampson, Sir George F. (Bart). Catalogue of the Lepidoptera Phalaenæ in the British Museum; Supplement, Vol. I, Catalogue of the Amatidæ and Arctiadæ, (Nolinæ and Lithosianæ). Received 19th January, 1915. Since the publication of the first two volumes of the "Catalogue of Moths" a large number of species in the families of which they treat have been described, and the newly published supplement brings the subject matter of Vols. I and II up to date. In the Family Amatidæ, 29 species are described as new, none of which, however, are

from North America. In the Arctiadæ, descriptions of 122 new species appear—all exotic. Plates, in colours, numbered I to XLI accompany the volume.

Herrick, Glenn W. Insects Injurious to the Household and Annoying to Man. New York, The Macmillan Company, pp. 1-470. This book which appeared late in 1914, was written particularly for the housekeeper and for those who desire information regarding household pests and practical methods of controlling them. The work is a valuable one and will certainly prove a handy volume of reference. It is profusely illustrated and is one of the Rural Science Series.

Holland, W. J. The Butterfly Guide: a pocket manual for the ready identification of the common species found in the United States and Canada. Published by Doubleday, Page & Co., New York. This pocket guide is similar in form to the popular bird, flower and tree guides. It consists of 237 pages and is illustrated with 295 colored figures, representing 255 species and varieties. There are also five plates, in explanation of structure, venation, metamorphosis, and the apparatus required for collecting, rearing and mounting specimens. This convenient little manual should have a ready sale among nature lovers generally.

Hopkins, A. D. Contributions Toward a Monograph of the Scolytid Beetles: Part II, Preliminary Classification of the Superfamily Scolytoidea. Tech. Series No. 17, United States Department of Agriculture, Bureau of Entomology: issued January 9th, 1915. The author states in the introduction that the object of this contribution is to discuss the taxonomy and present a preliminary classification of the families and subfamilies of the scolytid beetles of the world. The discussion and classification are based on a study of representatives of about 122 described and undescribed genera, and about 1,000 species of North America and other countries, in the collections of the United States National Museum and other institutions.

Howard, L. O., Dyar, H. G. and Knab, F. The Mosquitoes of North and Central America and the West Indies—Vol. Three, Systematic Description, Part I; Washington, D.C. Published by the Carnegie Institution of Washington, pp. 1-523. This sumptuous volume of descriptive matter appeared in October, 1915. The species of the tribes Sabethini and Culicini are described. Most of these are southern in distribution. Several species are described as new. Canadian records of nine species are given. Short chapters precede the descriptive matter, namely: "Mosquitoes, Their Definition and Position in the Classification of Insects," "Statement of Some of the Characters used in the Tables," "Outline of the Geographical Area Covered" and "Historical Sketch of the Classification of Mosquitoes."

Malloch, John R. The Chironomidæ, or Midges, of Illinois, with particular reference to the species occurring in the Illinois River; Bulletin of the Illinois State Laboratory of Natural History, Urbana, Ill., Article VI, Vol. X, May, 1915, pp. 275-538, plates XVII-XL. The opening chapters discuss "Methods of Collecting," "Methods of Rearing," "Methods of Preservation," "Synonymy Affecting Family Names" and "Biology and Taxonomy." Keys to the subfamilies follow, with a treatment of the Ceratopogoninæ, the Tanypinæ and the Chironominæ. The distribution of the Chironomidæ in the Illinois River is then stated and also a summary given of Illinois genera and species in comparison with those recorded for other states. Many species are described as new and a number of Canadian references given. The plates illustrate structural detail.

Morley, Claude. A Revision of the Ichneumonidæ based on the collection in the British Museum (Natural History), Part IV, Tribes Joppides, Banchides and Alomyides: British Museum (Natural History), 1915, pp. 167, 1 plate.

coloured. Part I appeared in 1912, Part II, in 1913, and Part III, in 1914. In Part IV, issued in March, 1915, 459 species are included, 40 of which are described as new. Records are given of a number of species from Canada which are in the British Museum, one of which is described as new.

PACKARD, The late ALPHEUS SPRING. Monograph of the Bombycine Moths of North America, Including their Transformations and Origin of the Larval Markings and Armature; Part III, Families Ceratocampidæ, Saturniidæ, Hemileucidæ and Brahmæidæ. Vol. XII, First Memoir, National Academy of Sciences, Washington, D.C., 516 pp., 4to, 113 plates, 34 of which depicting larvæ are colored. Edited by T. D. A. Cockerell. This, the third part of the late Dr. Packard's work on the Bombycine Moths, appeared in the first half of the year. It is indeed a most valuable contribution and one which will be welcomed by lepidopterists everywhere as the species described are not confined to North America but occur in various parts of the world. The successful issue of this sumptuous volume is largely due to Prof. Cockerell, who undertook to edit it.

RILEY, W. A., and JOHANNSEN, O. A. Handbook of Medical Entomology; Ithaca, N.Y., The Comstock Publishing Company, 1915, pp. 1-348. This handbook will be found of much value to those of our students who are interested in the study of medical entomology. It is an outgrowth of a course of lectures along the lines of insect transmission and dissemination of diseases of man, given by the senior author in the Department of Entomology of Cornell University, during the past six years. More especially is it an illustrated revision and elaboration of his "Notes on the Relation of Insects to Disease," published in January, 1912.

THOMPSON, MILLETT TAYLOR. An Illustrated Catalogue of American Insect Galls. Edited by E. P. Felt. Published and distributed by the Rhode Island Hospital Trust Company. Received, 26th June, 1915. This catalogue is divided into: Part I, Classification by Galls, and Part II, Classification by Genera. Both of these parts treat of the Cynipidæ. On pages 50 to 66 a "Supplemental List of American Gall-making Insects" is given. At the end of the volume are 21 plates, illustrating 247 different kinds of galls. These are from photographs and are splendid reproductions. This catalogue is an important contribution. It is to be regretted that only a portion of Dr. Thompson's investigation was completed at the time of his death.

WINN, A. F. and BEAULIEU, GERMAIN. A Preliminary List of the Insects of the Province of Quebec: Part II, Diptera. Published as a supplement to the 7th Report of the Quebec Society for the Protection of Plants; received 14th June, 1915. This publication of 159 pages is a welcome one and will undoubtedly be of much value to Canadian students of diptera. It is indeed a very creditable contribution. Under each genus the species known to occur in the Province of Quebec are listed, the definite localities and months of capture being recorded. A short introductory paragraph precedes each family.

COLLECTORS.

The following is a list of the names and addresses of collectors heard from during 1915:

Baird, Thos., High River, Alta.
Beaulieu, G., Ent. Branch, Dept. Agr., Ottawa.
Beaulne, J. I., Ent. Branch, Dept. Agr., Ottawa.
Bethune, Rev. Prof., O.A.C., Guelph.
Blackmore, E. H., Victoria, B.C.

Bowers, H. L., Oshawa, Ont.
Brimley, J. F., Wellington, Ont.
Brittain, W., Agric. College, Truro, N.S.
Bush, A. H., 1105 Broadway, Vancouver, B.C.
Caesar, L., O.A.C., Guelph, Ont.
Carr, F. S., Edmonton, Alta.
Chagnon, Gus., Box 521, Montreal.
Chagnon, W., St. John's, Que.
Chrystal, R. N., Ent. Branch, Dept. Agr., Ottawa.
Cockle, J. W., Kaslo, B.C.
Cosens, Dr A., Parkdale Collegiate Institute, Toronto.
Crew, R. J., 561 Carlaw Ave., Toronto.
Criddle, Evelyn, Aweme, Man.
Criddle, Norman, Aweme, Man.
Dawson, Horace, Hymers, Ont.
Day, G. O., Duncans, B.C.
Dod, F. H. Wolley-, Midnapore, Alta.
Dunlop, James, Woodstock, Ont.
Emile, Rev. Bro., Longueuil, Que.
Evans, J. D., Trenton, Ont.
Fyles, Rev. Dr. T. W., 268 Frank St., Ottawa.
Germain, Rev. Bro., Three Rivers, Que.
Gibson, Arthur, Ent. Branch, Dept. Agric., Ottawa.
Hahn, Paul, 433 Indian Road, Toronto.
Hanham, A. W., Duncan, B.C.
Harrington, W. H., P. O. Dept., Ottawa.
Hewitt, Dr. C. Gordon, Ent. Branch, Dept. Agric., Ottawa.
Hudson, A. F., Millarville, Alta.
Johnson, Geo. S., Moose Jaw, Sask.
Kitto, V., Inland Revenue, Dept. Interior, Ottawa.
Leavitt, A. G., St. John, N.B.
Macnamara, Chas., Arnprior, Ont.
McIntosh, W., St. John, N.B.
Mignault, Rev. J. B., Saint Lambert, Que.
Moore, G. A., 850 St. Hubert St., Montreal.
Perrin, Jos., McNab's Island, Halifax, N.S.
Petch, C. E., Hemmingford, Que.
Phair, A. W. H., Lillooet, B.C.
Ruhmann, Max M., Vernon, B.C.
Ross, W. A., Vineland Station, Ont.
Roy, Henri, Quebec, Que.
Sanders, G. E., Bridgetown, N.S.
Sanson, N. B., Banff, Alta.
Simpson, W., Dominion Observatory, Ottawa.
Simms, H. M., 192 Ontario East, Montreal.
Sladen, F. W. L., Experimental Farm, Ottawa.
Strickland, E. H., Experimental Station, Lethbridge, Alta.
Swaine, J. M., Ent. Branch, Dept. Agric., Ottawa.
Tams, W. H. T., Midnapore, Alta.
Taverner, P. A., Victoria Memorial Museum, Ottawa.
Tothill, J. D., Fredericton, N.B.

Treherne, R. C., Agassiz, B.C.
Venables, E. P., Vernon, B.C.
Walker, Dr. E. M., Univ. of Toronto, Toronto.
Wallis, J. B., 265 Langside St., Winnipeg, Man.
Whitehouse, F. C., Red Deer, Alta.
Willing, Prof. T. N., Univ. of Saskatchewan, Saskatoon, Sask.
Wilson, Tom, 1105 Broadway, Vancouver, B.C.
Winn, A. F., 32 Springfield Ave., Westmount, Que.
Young, C. H., Victoria Memorial Museum, Ottawa.

NOTES OF CAPTURES.

(Species preceded by an asterisk (*) described during 1915.)

Lepidoptera.

(Arranged according to Dyar's List of North American Lepidoptera, U.S. Nat. Museum Bull. No. 52.)

(Dyar's number.)

Papilionidæ.

16. *Papilio machaon* var. *aliaska* Scudd. Fort Chipewyan, Alberta, June 18, 1914, (F. Harper).

Sphingidæ.

730. *Smerinthus cerisyi* Kirby. Murray Bay, Que., July, (J. H. Holmes). Rare in Quebec Province. In Winn's list only two localities given—Cowansville and Montreal, (Gibson).

Saturniidæ.

766. *Pseudohazis hera* Harr. Recently I received a specimen of this species taken at Lillooet, B.C., (Phair). It is almost a perfect match to the specimen figured by Strecker on Plate XV of his Lepidoptera, Rhopaloceres and Heteroceres. Mr. Phair reported that he has only found the species where there is sage bush. Mr. Tom Wilson has also taken the insect at the same place. These are the first records I have for British Columbia, (Gibson).

Arctiidæ.

861. *Phragmatobia assimilans* Walk., var. *franconia* Slosson. Several at light, on Pine Creek, near Millarville, Alta., April 29, (Dod and Tams).
883. *Apantesis quenselii* Paykull. 141 Meridian, north of Mount Natazhat, July 1, 1913, (E. W. Nesham).
889. *Apantesis williamsii determinata* Neum. St. Agath, Que., June 25, 1910, (L. Gibb).

Noctuidæ.

996. *Apatela manitoba* Sm. Kaslo, B.C., (Cockle). First record from British Columbia.

1049. *Arsilonche henrici* Grt. Lethbridge, Alta., (Strickland). Rare in Alberta; the North American representative of European *albovenosa* (Dod).
Perigia albimacula B. & McD. Kaslo, B.C., (Cockle).

1145. *Hillia vigilans* Grt. Red Deer, Alta., Sept. 2, (Whitehouse and Tams).

1212. *Hadena passer* var. *incallida,* Walk. Lethbridge, Alta., (Strickland). This is the form with the ground colour pale ochreous. It has often passed in collections as *morna* Strk., (Dod).

1266. *Polia contacta* Walk. Kaslo, B.C., (Cockle).

1271. *Polia acutissima* Grt. Red Deer, Alta., Sept. 3, (Whitehouse and Tams). This is a prior name for *medialis* Grt. As it happens, the type of *acutissima* has the t.a. and the t.p. lines more deeply dentate than type *medialis.* The species has often been recorded from the West under the name of *confragosa* Morr., the correctness of which cannot at present be ascertained, (Dod).

1277. *Dryobota illocata* Walk. Red Deer, Alta., Sept. 4, (Whitehouse and Tams). New to Alberta, (Dod).

1297. *Heliotropha reniformis* Grt. Pine Creek, near Millarville, Alta., Aug. 27, (Tams). First record for this district, (Dod).

1324. *Oncocnemis hayesi* Grt. Kaslo, B.C., (Cockle).
Oncocnemis poliochroa Hamps. Kaslo, B.C., (Cockle).

1329. *Oncocnemis tenuifascia* Sm. Kaslo, B.C., (Cockle).

1331. *Oncocnemis levis* Grt. Lethbridge, Alta., (Strickland). Very rare in Canada, previously taken in the same locality by Mr. Wallis.

1339. *Oncocnemis riparia* Morr. Lethbridge, Alta., (Strickland).
Noctua dislocata Sm. Pine Creek, near Millarville, Alta., June 27, (Brill and Tams). Mr. Tams has prepared mounts of the genitalia of this and *calgary* and finds them very distinct. Those of *dislocata* are exactly like those of British *conflua,* whilst superficially *conflua* is much nearer to *calgary* than to *dislocata,* (Dod).

1483. *Noctua jucunda* Walk. St. John's, Que., (W. Chagnon). Only one record, "Meach Lake," in Winn's Quebec list. This latter is about 170 miles distant from St. John's, (Gibson).

1492. *Noctua patefacta* Sm. Lethbridge, Alta., (Strickland).

* *Rhizagrotis querula* Dod. Red Deer River, about 50 miles to the north-east of Gleichen, Alta., July 1, 3, 1915; July, 23, 24, 1907, (Hudson and Dod). Can. Ent. XLVII, 36. Recorded in 1906 and 1907 Ent. Records as *lagena.*

1535. *Feltia robustior* Sm. Lethbridge, Alta., (Strickland). First Alberta Record, (Dod).

1547. *Feltia vancouverensis* Grt. Pine Creek, near Millarville, Alta., June 24, (Tams). This species has rarely been met with before from east of the Rockies, one or two only having been recorded from Alberta. Mr. Strickland has found it not uncommon at Lethbridge. As a rule, there is less contrast between the light and dark shades than in Vancouver Island specimens, the dark shades being paler and less purplish and the ground colour decidedly darker, but occasional specimens from the two localities are almost exactly alike, (Dod).

Euxoa (*Rhizagrotis*) *perolivalis* Sm. Lethbridge, Alta., (Strickland). This species was referred to *Rhizagrotis* by Smith, by reason of the male antennæ being ciliate merely. The character does not appear to be quite constant, and one of the Lethbridge males has the antennæ more obviously serrate than any I had before seen, (Dod).

Euxoa pestula Sm. Lethbridge, Alta., (Strickland). This species is very close indeed to *pleuritica* Grt., and may be a dark form of it, (Dod).

Euxoa thanatologia var. *sordida* Sm. Lethbridge, Alta., (Strickland). Breeding results, in conjunction with a study of Kaslo, B.C., material and previous examination of type, has convinced me that *boretha* Sm. and *sordida* Sm. are both forms of one extraordinarily variable species previously described as *Porosagrotis thanatologia* by Dyar, but best referred to *Chorizagrotis* Smith, which Hampson treats as merely a section of *Euxoa*, (Dod).

1589. *Euxoa sponsa* Sm. Kaslo, B.C., (Cockle).

1590. *Euxoa choris* var. *cogitans* Sm. Lethbridge, Alta., (Strickland).

1593. *Euxoa hollemani* Grt. Maple Bay, Vancouver Island, B.C., Aug. 24, (Day).

1672. *Euxoa pallipennis* Sm. (Syn. *alcosta* Sm.). Lethbridge, Alta., Aug. 21, 1914, (Strickland). A new Canadian record, (Dod).

1689. *Euxoa holoberba* Sm. Kaslo, B.C., (Cockle).

1801. *Mamestra trifolii* Rott. Lethbridge, Alta., Aug. 20, 1914, (Strickland). A new Alberta record, all previous records being my *mutata*, which Hampson claims is a *Cardepia*, very close to *nova* Sm., (Dod).

1849. *Mamestra segregata* Sm. Bow River, at the mouth of Fish Creek, Alta., April 17-24, (Tams). Pine Creek, near Millarville, Alta., April 1, (Dod), and May 8 (Tams). *Segregata* was described from Laggan. *Gussata* Sm. described from here, appears to be a synonym of this, and *negussa* Sm., also described from here a variety without the blackish markings. The species is very variable, the forms easily intergrading, and an examination of male genitalia gives no evidence suggesting two species, (Dod).

2021. *Graphiphora uniformis* Sm. Lethbridge, Alta., (Strickland). The first Alberta record. This species has usually stood as *furfurata* or *peredia* in Manitoba collections. The two latter names refer to one species, very closely allied to *uniformis* (Dod).

2031. *Graphiphora præses* Grt. Kaslo, B.C., (Cockle). Not in Dyar's Kootenai list.

2048. *Stretchia muricina* Grt. Midnapore, Alta., April 12, 16, 28, May 12, (Dod and Tams). I have previously recorded the form occurring here as *plusiaeformis*, but whilst I have not so far recognized a distinct species under that name, I consider it probable that all Alberta and British Columbia specimens which I have seen are *muricina*, (Dod).

2067. *Cleoceris populi* Strk. Lethbridge, Alta., (Strickland).

Xylina viridis Dyar. Kaslo, B.C., (Cockle). Not in the Kootenai list.

2079. *Xylina petulca* Grt. Kaslo, B.C., (Cockle). Not in the Kootenai list.

2093. *Xylina ferrealis* Grt. Kaslo, B.C., (Cockle). Not in the Kootenai list.

2095. *Xylina innominata* Sm. Red Deer, Alta., Aug. 30, and Sept. 4, (Whitehouse and Tams). New to Alberta (Dod).

2113. *Xylina capax* G. and R. Blackfalds, Alta., Aug. 17-24, (Whitehouse). New to Alberta, (Dod).

2121. *Calocampa curvimacula* Morr. Kaslo, B.C., (Cockle). Recorded in B.C. list from Vancouver Island.

* *Papaipema humuli* Bird. Cartwright, Man.; Can. Ent. XLVII, 112.

2175. *Papaipema harrisii* Grt. Midnapore, Alta., bred from larvæ found in flower and leaf stems of *Heracleum lanatum,* emerged Aug. 18—Sept. 1, (Dod and Tams). This is the No. 368 of my Alberta list, formerly recorded as *impecuniosa* on Smith's authority. It was a great surprise to discover some numbers of the larvæ feeding close to my house, after I had been on the look out for it for years (Dod).

2205. *Conservula anodonta* Gn. Bondville, Que., July 20, (Winn). Rare in Quebec Province; only two localities given in Winn's list—St. Margaret and Meach Lake, (Gibson).

Orthosia aggressa Sm. Lethbridge, Alta., (Strickland). The first Alberta record. Described from Colorado and Cartwright, Man. Very close to *puta* Grt. (Syn. *euroa* Grt. and *dusca* Sm.), for a large specimen of which it might easily be taken. Its distinction is not unquestionable, (Dod).

2244. *Scopelosoma devia* Grt. Kaslo, B.C., (Cockle). Not in Dyar's Kootenai list.

2262. *Ipimorpha subvexa* Grt. Lethbridge, Alta., (Strickland). The first Alberta record. Recorded in last year's Record from Moose Jaw, Sask., (Dod).

2288. *Nycterophæta luna* Morr. Lethbridge, Alta., (Strickland).

2289. *Copablepharon grandis* Morr. Lethbridge, Alta., (Strickland).

2307. *Rhodophora florida* Gn. Lethbridge, Alta., (Strickland). First Alberta record, (Dod).

Autographa sansoni Dod. Kaslo, B.C., (Cockle). New to B.C. list.

2529. *Autographa snowi* Hy. Edw. Pine Creek, near Millarville, Alta., July 21, (Tams).

2846. *Catocala pura* Hulst. Red Deer and Blackfalds, Alta., Aug. 17 to Sept. 6, (Tams and Whitehouse). The species is very closely allied to *unijuga,* which occurs with it, but *pura* is more variable. It seems probable that *semirelicta* Grt. is the same species, though I am in doubt as to what exact forms the two names apply. According to Smith's catalogue, Grote repeatedly referred Hulst's name to his *semirelicta,* whilst Hulst persisted that the latter was a variety of *briseis.* Pale specimens of the latter are not unlike some forms of *pura,* (Dod).

2851. *Catocala mariana* Hy. Edw. Peachland, B.C., Aug. 6, 10, 1912, (Wallis). Dr. McDunnough informs me that as *mariana* is preoccupied in Europe, *edwardsi* Kuz. will have to be used instead, (Gibson).

3006. *Erebus odora* L. Although this southern species has previously been recorded from Quebec Province (Metis, Quebec, Montreal and Meach Lake), it is of interest to record the capture of a specimen at Newport, Gaspe Co., Que., Aug. 15, by Mrs. G. Chapados. The specimen was donated to the collection of the Ent. Branch by the collector through Miss J. McInnes (Gibson).

3072. *Bomolocha toreuta* Grt. Agassiz, B.C., Aug. 1 (Treherne).

Notodontidæ.

3150. *Schizura semirufescens* Walk. Agassiz, B.C., Aug. 1-15, (Treherne).

Geometridæ.

3236. *Nyctobia nigroangulata* Strk. Red Deer, Alta., April 18, (Whitehouse).

* *Hydriomena speciosata* var. *ameliata* Swett. Victoria, B.C., July 7, 9, 1914. (Blackmore); Can. Ent. XLVII, 64.

3387. *Hydriomena nubilifasciata* var. *cupidata* Swett. Quamichan district, B.C., May 22, 1914, new to B.C. list. Identified by Mr. Swett, who stated that this is a rare variety and rather unexpected from British Columbia. He had only seen the variety from California, (Day).

* *Hydriomena grandis* var. *saawichata* Swett. Victoria, B.C., May 5 to June 20, 1914, (Blackmore); Can. Ent. XLVII, 157.

3393. *Hydriomena edenata* Swett. Mt. Tzouhalem, B.C., Apl. 5, (Hanham).

3401. *Hydriomena multiferata* Walk. Midnapore, Alta. (de Mille's Lumber Mill), July 13, (Brill and Tams).

* *Stamnodes blackmorei* Swett. Victoria, B.C., July 2-27, 1913; July 3, 1914, (Blackmore); Can. Ent., XLVII, 155.

* *Petrophora defensaria* var. *mephistaria* Swett. Victoria, B.C., Jan. 9, 1909; Ladysmith, B.C., Feb. 3, 1906, (C. Livingston); Victoria, B.C., (Blackmore); Can. Ent. XLVII, 156.

3450. *Xanthorhoe abrasaria* H.-S. Midnapore, Alta. (de Mille's Lumber Mill), July 13, (Brill and Tams).

3605. *Orthofidonia exornata* Walk. Pine Creek, near Millarville, Alta., May 6, (Tams).

3784. *Alcis sulphuraria* Pack. Lethbridge, Alta., (Strickland). The only previous Alberta record was one taken at Midnapore and recorded in the 1914 Ent. Record, (Dod).

3804. *Spodolepis substriaria* Hulst. Pine Creek, near Millarville, Alta., April 29, (Dod).

3867. *Lycia cognataria* Gn. Quamichan Lake, B.C., April 2, (Hanham).

3963. *Euchlæna astylusaria* Walk. Pine Creek, near Millarville, Alta., May 31, (Tams).

3976. *Synaxis pallulata* Hulst. Quamichan Lake, B.C., Sept. 15, (Hanham).

4016. *Sabulodes lorata* Grt. Lethbridge, Alta., (Strickland); only one specimen previously recorded from Alberta, (Dod).

4026. *Sabulodes transversata* Dru. Lethbridge, Alta., (Strickland). New to Alberta, (Dod).

4040. *Leucobrephos brephoides* Walk. Klutlan Glacier, elev. 5,500 feet, (141 Meridian, north of Mt. Natazhat), May 2, 1913, (E. W. Nesham). Mr. Dod tells me that this insect was common in 1915 on Pine Creek, near Millarville, Alta., April 7-10, (Tams), flying in sunshine, (A. G.).

Tortricidæ.

5207. *Episimus argutanus* Clem. Aweme, Man., reared from *Rhus toxicodendron*, (N. Criddle).

5367. *Archips negundana* Dyar. Aweme, Man., July 8, 1914, (N. Criddle).

5396. *Tortrix pallorana* Rob. Aweme, Man., July 16, 1914, (N. Criddle).

Yponomeutidæ.

5191. *Trachoma falciferella* Walsm. Quamichan Lake, B.C., March 21, the second I have captured, (Hanham).

Gelechiidæ.

Recurvaria nanella Hbn. Toronto, Ont., reared from pear, (Cosens), Bridgetown, N.S., July 30, (Sanders).

* *Gnorimoschema gibsoniella* Busck. Aweme, Man., (N. Criddle); Proc. Ent. Soc. Wash. XVII, 82.

Elachistidæ.

* *Coleophora manitoba* Busck. Aweme, Man., (N. Criddle); Proc. Ent. Soc. Wash., XVII, 88.

6179. *Walshia amorphella* Clem. Aweme, Man., July 25, 1914, (N. Criddle).

Tineidæ.

* *Incurvaria itoniella* Busck. Kaslo, B.C., (Cockle); Proc. Ent. Soc. Wash., XVII, 92.

Coleoptera.

(Arranged according to Henshaw's list of Coleoptera of America, North of Mexico.)

Cicindelidæ.

18c. *Cicindela longilabris* var. *montana* Lec. Athabaska Landing, Alta., Aug. 11, (Strickland).

34. *Cicindela pusilla* Say. Estevan, Sask., June 20, (N. Criddle).

Carabidæ.

408. *Bembidium dubitans* Lec. Vernon, B.C., April 10, (Ruhmann).

416. *Bembidium mutatum* G. & H. Agassiz, B.C., (Treherne).

422. *Bembidium trechiforme* Lec. Agassiz, B.C., (Treherne).

* *Trechus borealis* Schaeffer. Labrador, Battle Harbor, (Engelhardt); Bay of St. George, Newfoundland, (Engelhardt). Jour. N.Y. Ent. Soc. XXIII, 47.

510. *Pterostichus brunneus* Dej. Armstrong, B. C., Sept. 12, (Ruhmann).

558. *Pterostichus scitulus* Lec. Vernon, B.C., July, 1914, (Ruhmann).

571. *Pterostichus corvinus* Dej. Winnipeg, Man., April 29, 1911, (Wallis).

578. *Pterostichus mutus* Say. Winnipeg, Man., June 10, 1910, (Wallis).

643. *Amara adstrictus* Putz. Miami, Man., Aug. 14, 1914, (Wallis).

749. *Calathus advena* Lec. Vernon, B.C., Aug. 1914, (Ruhmann).

750. *Calathus impunctatus* Say. Husavick, Man., Aug. 2, 1912, (Wallis).

776. *Calathus piceolus* Lec. Winnipeg, Man., May 3, 1911, (Wallis).

818. *Platynus cupreus* Dej. Agassiz, B.C., (Treherne).

1067. *Discoderus parallelus* Hald. Peachland, B.C., July 21, 1912, (Wallis).

1084. *Harpalus faunus* Say. Winnipeg, Man., June 18, 1911, (Wallis).

1087b. *Harpalus longior* Kirby. Winnipeg, Man., June 2, 1911, (Wallis).

1090. *Harpalus fulvilabris* Mann. Winnipeg, Man., June 1, 1912, (Wallis).

1096. *Harpalus ventralis* Lec. Treesbank, Man., July 26, 1910; Miami, Man., July 1, 1914, (Wallis).

1106. *Harpalus lewisii* Lec. Miami, Man., July 21, 1914, (Wallis).

Amphizoidæ.

1215. *Amphizoa insolens* Lec. Peachland, B.C., July 13, 1912. (Wallis).

Staphylinidæ.

2124. *Staphylinus badipes* Lec. St. Rose, Que., April 22, 1911. (Beaulne).
* *Philonthus pumilio* Casey. Aweme, Man., (N. Criddle): Memoirs on the Coleoptera, VI, 431, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus nematocerus* Casey. Metlakatla, B.C., (Keen): Memoirs on the Coleoptera, VI, 437, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus ottawensis* Casey. Ottawa, Ont., (Harrington): Memoirs on the Coleoptera, VI, 438, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus cephalicus* Casey. Aweme, Man., (N. Criddle): Memoirs on the Coleoptera, VI, 438, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus linearis* Casey. Metlakatla, B.C., (Keen); Memoirs on the Coleoptera, VI, 439, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus vulgatus* Casey. Ottawa: Memoirs on the Coleoptera, VI, 442, by Thos. L. Casey, issued Nov. 27, 1915.
* *Philonthus finitimus* Casey. Hull, Que., (Beaulne): Memoirs on the Coleoptera, VI, 443, by Thos. L. Casey, issued Nov. 27, 1915.
* *Megaquedius manitobensis* Casey. Aweme, Man., (N. Criddle); Memoirs on the Coleoptera, VI, 423, by Thos. L. Casey, issued Nov. 27, 1915.
* *Quediochrus quadriceps* Casey. Aweme, Man., (N. Criddle); Memoirs on the Coleoptera, VI, 421, by Thos. L. Casey, issued Nov. 27, 1915.
* *Microsaurus curtipennis* Casey. Aweme, Man., (N. Criddle): Memoirs on the Coleoptera, VI, 414, by Thos. L. Casey, issued Nov. 27, 1915.
* *Microsaurus breviceps* Casey. Stikine River, B.C., (Wickham): Memoirs on the Coleoptera, VI, 411, by Thos. L. Casey, issued Nov. 27, 1915.
* *Microsaurus criddlei* Casey. Aweme, Man., (N. Criddle); Memoirs on the the Coleoptera, VI, 410, by Thos. L. Casey, issued Nov. 27, 1915.
* *Microsaurus canadensis* Casey. Kazubazua, Que., (Beaulne); Memoirs on the Coleoptera, VI, 409, by Thos. L. Casey, issued Nov. 27, 1915.
* *Distichalius oculens* Casey. Inverness, B.C., (Keen); Memoirs on the Coleoptera, VI, 407, by Thos. L. Casey, issued Nov. 27, 1915.
* *Distichalius agnatus* Casey. Aweme, Man., (N. Criddle); Memoirs on the Coleoptera, VI, 406, by Thos. L. Casey, issued Nov. 27, 1915.

Orus punctatus Casey. Agassiz, B.C., (Treherne).

2501. *Hesperobium californicum* Lec. Agassiz, B.C., (Treherne).

2863. *Anthobium pothos* Mann. Ottawa, Ont., May, 13, (Germain).

Phalacridæ.

3007. *Olibrus nitidus* Melsh. Ottawa, Ont., May 31, (Germain).

Corylophidæ.

Orthoperus brunneus Casey. Ottawa, May, (Germain).

Coccinellidæ.

Anatis lecontei Casey. Lethbridge, Alta., July 27, (Strickland).

3089. *Pentilia marginata* Lec. Ottawa, Ont., June 17, (Germain).

Corydiidæ.

3281. *Dcretaphrus oregonensis* Horn. Peachland, B.C., July 13, 1912, (Wallis).

Cucujidæ.

3348. *Dendrophagus glaber* Lec. Bird's Hill, Man., May 6, 1911, (Wallis).

Cryptophagidæ.

3363. *Paramecosoma serratum* Gyll. Ottawa, Ont., June 27, 1914, (Germain).
3443. *Trogoderma tarsale* Melsh. Ottawa, Ont., July 12, 1914, (Germain).

Histeridæ.

3495. *Hister furtivus* Lec. Millarville, Alta., April, May, 1914, (Tams).
3533. *Epierus regularis* Beauv. Ottawa, Ont., July 3, (Germain).
3552. *Paromalus æqualis* Say. Husavick, Man., June 22, 1912; under debris on lake beach, (N. Criddle and Wallis).
3586a. *Saprinus distinguendos* Mars. Winnipeg, Man., June 1, 1912, (Wallis).
3588. *Saprinus infaustus* Lec. Peachland, B.C., July 19, 1912, (Wallis). Dr. Fall when determining the specimen stated that probably this beetle is the one that Horn mentions in his Synopsis as possibly a form of *infaustus*.
3602. *Saprinus incertus* Lec. Peachland, B.C., July 22, 1912, (Wallis).
3610. *Saprinus fimbriatus* Lec. Peachland, B.C., July 22, 1912, (Wallis).

Elateridæ.

4115. *Cardiophorus amplicollis* Mots. Grand Forks, B.C., 1913, (Ruhmann).
4252. *Drasterius livens* Lec. Grand Forks, B.C., 1913, (Ruhmann).
4415. *Paranomus estriatus* Lec. Ottawa, Ont., June 25, (Germain).

Throscidæ.

4548. *Throscus invisus* Horn. Ottawa, Ont., June 17, (Germain).

Buprestidæ.

10,112. *Agrilus masculinus* Horn. Aweme, Man., June 5, (N. Criddle).

Lampyridæ.

4914. *Silas munita* Lec. Vernon, B.C., April 8, (Ruhmann).

Malachidæ.

5030. *Malachius ulkei* Horn. Aweme, Man., May 31, (N. Criddle).

Ptinidæ.

Ptinus villiger Reit. Winnipeg, Man., May 17, 1911, (Wallis).
10,149. *Xestobium elegans* Horn. Winnipeg, Man., May 23, 1911, (Wallis).
5265. *Oligomerus obtusus* Lec. Ottawa, Ont., June 25, (Germain).

Scarabæidæ.

5439. *Canthon perplexus* Lec. Macleod, Alta., June 30, 1902, (J. Fletcher).
5510. *Aphodius hamatus* Say. Quebec, Que., (Roy).

5629. *Trox scaber* L. Miami, Man., July 1, 1914, (Wallis).
5648. *Hoplia laticollis* Lec. Aweme, Man., July, 1903 to 1910, (Criddle Bros.). First Canadian record we have.
Serica intermixta Blatchley. Aweme, Man., May 26, 1910, (E. Criddle).
5686. *Serica anthracina* Lec. Vernon, B.C., April 8, (Ruhmann).
5705. *Diplotaxis obscura* Lec. Aweme, Man., April, May, (Criddle Bros.).
Lachnosterna grandis Smith. Halifax, N.S., July 18, (Perrin). It is also interesting to record the capture of a specimen on Sable Island. A single specimen was received at Ottawa with a small collection of lepidoptera. Sable Island is about 110 miles due east of Guysborough County in Nova Scotia.
* *Anomala* (subq. *Paranomala*) *canadensis* Casey. Ontario, Canada; Memoirs on the Coleoptera, VI, 33, by Thos. L. Casey, issued Nov. 27, 1915.
* *Cremastocheilus pocularis* Casey. Aweme, Man., (Criddle); Memoirs on the Coleoptera, VI, 33, by Thos. L. Casey, issued Nov. 27, 1913.

Cerambycidæ.

5973. *Nothorhina aspera* Lec. Peachland, B.C., July 12, 1912, (Wallis).
6201. *Neoclytus erythrocephalus* Fab. Miami, Man., July 2, 1914, (Wallis).
6252. *Anthophylax viridis* Lec. Halifax, N.S., Aug. 22, (Perrin).
6259. *Acmæops bivittata* Say. Miami, Man., July 3, (Wallis).
6304. *Leptura subhamata* Rand. Halifax, N.S., Aug. 21, (Perrin).
6332a. *Leptura erythroptera* Kirby. Halifax, N.S., Aug. 22, (Perrin).

Chrysomelidæ.

6531. *Donacia porosicollis* Lec. Onah, Man., May 24, 1912, in flowers of Marsh Marigold, (S. and E. Criddle and Wallis).
6535. *Donacia distincta* Lec. Ottawa, Ont., July, 1913, (Germain).
6538. *Donacia pubescens* Lec. Winnipeg, Man., June 22, 1912, (Wallis).
6539. *Donacia æqualis* Say. Ottawa, Ont., July, 1913, (Germain).
6541. *Donacia emarginata* Kirby. Ottawa, Ont., July, 1913, (Germain).
6545. *Donacia metallica* Ahr. Ottawa, Ont., July, 1913, (Germain).
6550. *Donacia atra* var. *childreni* Kirby. Winnipeg, Man., May 28, 1911, (Wallis). The same collector has also taken at Winnipeg the varieties *tibialis* (June 29) and *trivittata* (June 17).
10,337. *Syneta hamata* Horn. Vernon, B.C., April 9, (Ruhmann).
* *Pachybrachys relictus* Fall. Toronto, Ont.; Trans. Amer. Ent. Soc., XLI, 424.
* *Pachybrachys carborarius janus* Fall. Brandon, Man.; Trans. Amer. Ent. Soc., XLI, 462.
Pachybrachys elegans Blatchley. Winnipeg, Man., June 24, 1911, (Wallis).
Tymnes canellus var. *thoracica* Melsh. Winnipeg, Man., June 24, 1911, (Wallis).
6769. *Graphops marcassita* Cr. Winnipeg, Man., (Wallis); Ottawa, Ont., May 25, (Germain).
6809a. *Chrysomela spirææ* Say. Treesbank, Man., April 17, 1908, (Wallis).
6905. *Galerucella nymphææ* L. Fort Chipewyan, Alta., June 13, (F. Harper).
6920. *Hypolampis pilosa* Ill. Winnipeg Beach, Man., Aug. 25, 1910, (Wallis).
6974. *Haltica tombacina* Mann. Ottawa, Ont., May 25, (Germain).

Bruchidæ.

7135. *Bruchus aureolus* Horn. Aweme, Man., July 6, (N. Criddle).

Tenebrionidæ.

Eleodes letcheri var. *vandykei* Blaisd. Vernon, B.C., April 8, (Ruhmann).
7355. *Eleodes cordata* var *rotundipenne* Lec. Vernon, B.C., April 8, (Ruhmann).
7391. *Nyctobates pennsylvanica* DeG. Winnipeg, Man., May 5, 1911, (Wallis).
Arrhenoplita bicornis Oliv. Ottawa, Ont., May and June, (Germain).

Cistelidæ.

7631. *Androchirus erythropus* Kirby. Ottawa, Ont., July 21 (Germain).

Melandryidæ.

7653. *Melandrya striata* Say. Winnipeg, Man., June 19, 1912, (Wallis).
7655. *Emmesa labiata* Say. Quebec, Que., (Roy).
7658. *Xylita lævigata* Hellw. Ottawa, Ont., Aug., 1914, (Germain).
7663. *Scotochroa atra* Lec. Ottawa, Ont., July 18, 1914, (Germain).
7664. *Scotochroa basalis* Lec. Ottawa, Ont., June 12, (Germain).
7666. *Serropalpus barbatus* Schall. Winnipeg, Man., July, 1909, (Wallis).

Pythidæ.

7708. *Boros unicolor* Say. Winnipeg, Man., June 4, 1914, (Wallis).

Mordellidæ.

7804. *Mordellistena intermixta* Helm. Miami, Man., July 6, 1914, (Wallis).

Anthicidæ.

Stereopalpus vestitus Say. Ottawa, Ont., July 14, (German).

Pyrochroidæ.

7997. *Dendroides ephemeroides* Mann. Agassiz, B.C., June 20, (Treherne).

Otiorhynchidæ.

8261. *Panscopus erinaceus* Say. Ottawa, Ont., July 3, (Germain).
8285. *Otiorhynchus rugifrons* Gyll. Ottawa, Ont., July 1, (Germain).
8293. *Mylacus saccatus* Lec. Vernon, B.C., April 10, (Ruhmann).

Curculionidæ.

8673. *Orchestes pallicornis* Say. Ottawa, Ont., July 29, (Germain).
8688. *Proctorus decipiens* Lec. Ottawa, Ont., June 3, (Germain).
Cœliodes apicalis Dietz. Ottawa, Ont., June 29, (Germain).

Scolytidæ.

* *Pityogenes hopkinsi* Swaine. "In limbs of pine throughout eastern part of Canada and United States"; Tech. Publication No. 2, N.Y. State College of Forestry, Vol. XVI, 7.

* *Ips perroti* Swaine. Isle Perrot, Que., 1912, (Swaine): Can. Ent., XLVII, 357.
* *Dryocœtes sechelti* Swaine. Sechelt, B.C., Can. Ent., XLVII, 359.
* *Dryocœtes piceæ* Hopk. "North Carolina to Canada, and westward to Michigan"; Rep. No. 99, U. S. Dep. Agr., Office of the Secretary, p. 51, issued March 10, 1915.
* *Dryocœtes pseudotsugæ* Swaine. Inverness and Vancouver, B.C., Can. Ent., XLVII, 360.
* *Phlœosinus pini* Swaine. Riding Mts., Man., (Swaine): Can. Ent. XLVII, 362.
* *Hylastes ruber* Swaine. Golden, B.C., Creighton Valley, B.C., Can. Ent., XLVII, 367.
* *Conophthorus resinosæ* Hopk. "Ontario, Canada," (Harrington); Jour. Wash. Acad. Sci., Vol. V, 431.
* *Conophthorus monticolæ* Hopk. "Cowitche Lake, Canada," Jour. Wash. Acad. Sci., Vol. V, 432. The locality should be corrected to read "Cowitchan Lake, B.C."

Diptera.

(Arranged according to a catalogue of North American Diptera, by J. M. Aldrich. Smithsonian Misc. Coll. XLVI, No. 1, 444. The numbers refer to the pages in the catalogue.)

Large collections of these insects have been made in certain of the provinces during 1915. The appearance of Winn and Beaulieu's list of Quebec diptera will doubtless encourage collectors in that province to add to the list. Recently we had the pleasure, at Ottawa, of a visit from Prof. J. M. Aldrich, who came to study the collection of diptera in the collection of the Entomological Branch. Many species were determined by him, and the records of a number of these are undoubtedly new to Canada.

Tipulidæ.

* *Dicranomyia aquita* Dietz. Described in Can. Ent. XLVII, 331. The type localities there given, viz.: "Fort Resolution, Aug. 24, 1914: Island at mouth of Rocker River, Aug. 16, 1914, (F. Harper)" were tentative ones, I am informed by Mr. Harper, and should be corrected to read, "District of Mackenzie along the south shore of Great Slave Lake," (Gibson).
* *Limnobia gracilis* Dietz. Described in Can. Ent. XLVII, 329. The type locality there given, viz.: "Tsolinoi, about 5 miles north of Athabaska Lake, July 5, 1914, (F. Harper)," should be corrected to read, Tsal-wor Lake, Sask., about 8 miles from the north shore of Lake Athabaska at a point about midway of its length, (Gibson).
* *Gonomyia mathesoni* Alex. Truro, N.S., July 7-26, 1913, (R. Matheson); Ent. News, XXVI, 170.
* *Limnophila* (*Dactylolabis*) *hortensia* Alex. London Hill Mine, Bear Lake, B.C., July 29, 1903, (A. N. Caudell); Proc. Acad. Nat. Sciences, Philadelphia, LXVI, 591.
* *Phalacrocera neoxena* Alex. Nipigon, Ont., June 17, 1913, (Walker). Proc. Acad. Nat. Sciences, Philadelphia, LXVI, 603.

100. *Tipula angustipennis* Loew. Vernon, B.C., (Ruhmann); Athabaska River, between Grand Rapids and mouth of Little Buffalo River, Alta., May 24, 25, 1914, (F. Harper).
101. *Tipula serta* Loew. Soulier Lake, southern Mackenzie, July 18-22, 1914, (F. Harper).
104. *Tipula tessellata* Loew. Lake Athabaska, near mouth of Charlot River, northern Saskatchewan, June 29, 1914, (F. Harper).

Chironomidæ.

108. *Ceratopogon cockerelli* Coq. Banff, Alta., Aug. 29, 1910, (Sanson).

Culicidæ.

132. *Grabhamia curriei* Coq. Banff, Alta., June 26, 1909, (Sanson).

Cecidomyidæ.

* *Dasyneura torontoensis* Felt. Toronto, Ont., May 3, 1915, (Cosens); Jour. Econ. Ent. 8, 405.

Bibionidæ.

164. *Plecia heteroptera* Say. DeGrassi Point, Lake Simcoe, Ont., Aug. 26, 1914, (Walker).
166. *Bibio nervosus* Loew. Vernon, B.C., (Ruhmann).
166. *Bibio nigripilus* Loew. Ottawa, Ont., May and June, (Germain).
166. *Bibio obscurus* Loew. Banff, Alta., Sept. 29, 1911, (Sanson).
166. *Bibio xanthopus* Wied. Ottawa, Ont., June 18, (Germain).
167. *Dilophus serraticollis* Walk. Banff, Alta., Sept. 29, 1911, (Sanson).
167. *Aspistes analis* Kirby. Banff, Alta., (Sanson.)
168. *Scatopse pygmaea* Loew. Ottawa, Ont., May 30, (Germain); Toronto, Ont., June 7, 1914, (Walker).

Simuliidæ.

169. *Simulium bracteatum* Coq. Ottawa, Ont., May 12, (Germain).
170. *Simulium vittatum* Zett. Ottawa, Ont., May 5, (Germain).

Stratiomyidæ.

179. *Sargus decorus* Say. Departure Bay, B.C., July 25, 1913, (Walker); Toronto, Ont., May 4, June 11, 1914, (Walker).
180. *Sargus viridis* Say. Spruce Brook, Nfd., July 29, 1914, (Walker).
182. *Stratiomyia discalis* Loew. Kelowna, B.C., June 2, 1914 (Ruhmann).
183. *Stratiomyia lativentris* Loew. Prince Albert, Sask., June 26, 1913, (Walker).
183. *Stratiomyia nymphis* Walk. Banff, Alta., Aug. 5, 1909, (Sanson).
184. *Stratiomyia normula* Loew. Prince Albert, Sask., June 29, 1913, (Walker).

Tabanidæ.

194. *Pangonia tranquilla* O. S. Halifax, N.S., Aug. 20, 22, (Perrin).
195. *Chrysops callidus* O. S. Toronto, Ont., June 30, 1914, (Walker).
195. *Chrysops celer* O. S. Prince Albert, Sask., June 23, 1912, (Walker); Spruce Brook, Nfd., July 27, 1914, (Walker).
196. *Chrysops carborarius* Walk. Toronto, Ont., June 7, 1914, (Walker).

196. *Chrysops frigidus* O. S. Spruce Brook, Nfd., July 29, 1914, (Walker).
197. *Chrysops montanus* O. S. Ottawa, Ont., May 20, (Germain).
197. *Chrysops niger* Macq. Spruce Brook, Nfd., July 27, 1914, (Walker); Toronto, Ont., June 13, 1914, (Walker).
197. *Chrysops plangens* Wied. MacNab's Island, Halifax, N.S., July 19, 1914, (Perrin).
201. *Tabanus astutus* O. S. MacNab's Island, Halifax, N.S., Aug. 16, 1914, (Perrin).
   Tabanus centron Marten. Fort McMurray, Alta., May 29; Fort Chipewan, June 16-18, (F. Harper).
   Tabanus fulvescens Walk. MacNab's Island, Halifax, N.S., Aug. 2, 1914, (Perrin).
208. *Tabanus stygius* Say. Pt. Pelee, Ont., July 19, 1913, (Taverner and Young).

Leptidæ.

   Arthropeas magna Jns. Calgary, Alta., (J. Fletcher): Aweme, Man., June 20, 1903, (N. Criddle).
212. *Rhachicerus nitidus* Jns. Lake McGregor, Que., July 12, (Germain). New to Quebec Province.
214. *Triptotricha disparilis* Bergr. Agassiz, B.C., Aug., (Treherne).
214. *Leptis [illegible]* Bigot. Vancouver, B.C., June, 1914, (Chrystal).
215. *Leptis plumbea* Say. Jordan, Ont., May 10, (Ross).
215. *Leptis scapularis* Loew. Bowmanville, Ont., July 10, 1913, (Ross); Lake McGregor, Que., July 12, (Germain).
216. *Chrysopila ornata* Say. Jordan, Ont., June 16, (Ross).
216. *Chrysopila proxima* Walk. Toronto, Ont., June 13, 1914, (Walker).
217. *Symphoromyia atripes* Bigot. Banff, Alta., (Sanson): Lake Louise, Alta., July 20, (Ruhmann).
217. *Symphoromyia hirta* Jns. Prince Albert, Sask., July [illegible], (J. Fletcher).
   * *Symphoromyia kincaidi* Aldrich. Victoria, B.C., Aug. 6, 1903, (Kincaid): Gabriola Island, B.C., May 30, 1908, B. Elliott, (Kincaid); Stickeen River Canyon, B.C., (Wickham): Proc. U. S. N. M. Vol. 49, 129.
   * *Symphoromyia montana* Aldrich. Prince Albert, Sask., May 18, 1905, (Willing): Ungava Bay, (Turner); Farewell Creek, Sask., (C. W. J.); Proc. U. S. N. M. Vol. 49, 133.
217. *Symphoromyia plangens* Will. Elbert, B.C., June 19, 1914, (Chrystal).

Nemestrinidæ.

219. *Rhynchocephalus sackeni* Will. Vernon, B.C., June 23, 1902.

Bombyliidæ.

223. *Spogostylum pluto* Wied. De Grassi Point, Lake Simcoe, Ont., Aug. 14, 1895, (Walker).
230. *Anthrax fulviana* Say. De Grassi Point, Lake Simcoe, Ont., Aug. 28, 1914, (Walker).
230. *Anthrax fulviana* var. *nigricauda* Loew. Banff, Alta., July 25, 1910, (Sanson).
236. *Bombylius lancifer* O. S. Kelowna, B.C., June 2, 1914, (Ruhmann).

Therevidæ.

247. *Psilocephala munda* Loew. Banff, Alta., July 16, 1909, (Sanson).
248. *Thereva flavicincta* Loew. St. Johns, Que., Record from Stettiner Entomologische Zeitung, 1912, p. 261. New to Quebec list.

Mydaidæ.

251. *Mydas clavatus* Dru. Pt. Pelee, Ont., July 19, 1913, (Taverner and Young).

Asilidæ.

254. *Leptogaster badius* Loew. Jordan, Ont., June 29, (Ross).
Laphystia flavipes Coq. Aweme, Man., July 13, 1907, (J. Fletcher).
258. *Myelaphus lobicornis* O. S. Invermere, B.C., June 30, 1914, (Sladen).
259. *Cyrtopogon dasyllis* Will. Banff, Alta., (Sanson).
260. *Cyrtopogon nebulo* O. S. Banff, Alta., March 6, 1911, (Sanson).
269. *Atomosia puella* Wied. Jordan, Ont., Jan. 29, (Ross).
271. *Dasyllus columbica* Walk. Banff, Alta., June 30, 1913, (Walker).
271. *Dasyllis thoracica* Fabr. De Grassi Point, Lake Simcoe, Ont., July 2, 1896, (Walker).
272. *Laphria pubescens* Will. Sudbury, Ont., June 7, 1913, (Walker).
273. *Laphria vultur* O. S. Kaslo, B.C., June, (Cockle).
281. *Tolmerus callidus* Will. Banff, Alta., July 11, 1911, (Sanson).
282. *Tolmerus notatus* Wied. De Grassi Point, Lake Simcoe, Ont., Aug. 23, 1914, (Walker).
282. *Asilus annulatus* Will. Toronto, Ont., Aug. 8, 1914, (Walker).
283. *Asilus orphne* Walk. Lake McGregor, Que., July 23, (Germain).
283. *Asilus paropus* Walk. Jordan, Ont., Aug. 6, 1914, (Ross).

Dolicopodidæ.

285. *Psilopodinus patibulatus* Say. Lake Louise, Alta., July 4, 1914, (Ruhmann).
289. *Chrysotus obliquus* Loew. Bridgetown, N.S., Aug. 29, 1912, (Sanders).
291. *Argyra albicans* Loew. Toronto, Ont., June 13, 1914, (Walker).
293. *Sympycnus lineatus* Loew. Brockville, Ont., Aug. 23, 1903, (W. Metcalfe).
296. *Medeterus veles* Loew. Aweme, Man., June 12, (N. Criddle).
* *Thrypticus comosus* Van Duzee. Toronto, Ont., July 4; Psyche, XXII, 86.
299. *Dolichopus bifractus* Loew. Aweme, Man., July 6, (N. Criddle): Dauphin, Man., June 22, 1913, (Walker).
300. *Dolichopus brevipennis* Meigen. Summerside, P.E.I., Aug. 21, 1914, (Walker).
301. *Dolichopus cuprinus* Wied. Dauphin, Man., June 22, 1913, (Walker).
301. *Dolichopus dakotensis* Ald. Dauphin, Man., June 22, 1913, (Walker).
301. *Dolichopus eudactylus* Loew. Jordan, Ont., June 12, (Ross).
304. *Dolichopus reflectus* Ald. Jordan, Ont., July 8, (Ross).
304. *Dolichopus renidescens* M. & B. Dauphin, Man., June 22, 1913, (Walker).
306. *Gymnopternus tristis* Loew. Vancouver, B.C., June 30, 1914, (Chrystal).

Empidæ.

311. *Drapetis medetera* Melan. Aweme, Man., Sept. 21, (N. Criddle).
311. *Platypalpus æqualis* Loew. Ottawa, Ont., June 18, (Germain).
312. *Platypalpus crassifemoris* Fitch. Aweme, Man., July 20, (N. Criddle).

313. *Tachydromia pusilla* Loew. Ottawa, Ont., May and June, (Germain).
318. *Syneches thoracicus* Say. Lake McGregor, Que., July 12, (Germain). New to Quebec Province.
319. *Leptopeza compta* Coq. Ottawa, Ont., July 16, (Germain).
319. *Ocydromia glabricula* Fallen. Aylmer, Que., June, (Germain). New to Quebec Province.
326. *Hilara tristis* Loew. Spruce Brook, Nfd., July 27, 1914, (Walker).
331. *Rhamphomyia irregularis* Loew. Ottawa, Ont., July 3, (Germain).
331. *Rhamphomyia lævigata* Loew. Ottawa, Ont., July 3, (Germain).
331. *Rhamphomyia longicauda* Loew. Toronto, Ont., July 12, 1914, (Walker).
332. *Rhamphomyia pulla* Loew. Toronto, Ont., May 31, 1914, (Walker).
Microsania imperfecta Loew. Aweme, Man., Sept. 18, (Criddle).

Phoridæ.

339. *Gymnophora arcuata* Meigen. Ottawa, Ont., July and August, (Germain).

Platypezidæ.

340. *Agathomyia notata* Loew. Ottawa, Ont., June 27, (Germain).

Pipunculidæ.

342. *Chalarus spurius* Fallen. Ottawa, Ont., July 20, (Germain).
Pipunculus appendiculatus Cr. Aweme, Man., July 6, (N. Criddle).
343. *Pipunculus albofasciatus* Hough. Ottawa, Ont., May and June, (Germain).
343. *Pipunculus cingulatus* Loew. Ottawa, Ont., May and June, (Germain).
Pipunculus confraternus Banks. Aweme, Man., July 23, (N. Criddle).
343. *Pipunculus flavomaculatus* Hough. Ottawa, Ont., May and June, (Germain).

Syrphidæ.

346. *Microdon tristis* Loew. Field, B.C., July 1, 1908, (J. C. Bradley); Vineland, Ont., June 4. (Ross and Curran).
348. *Chrysotoxum ventricosum* Loew. Revelstoke, B.C., July 8-13, 1905, (J. C. Bradley).
348. *Chrysogaster bellula* Will. Vineland, Ont., Aug. 18, 1914, (Ross and Curran).
349. *Chrysogaster stigmata* Will. Carbonate to Prairie Hills, Selkirk Mts., B.C., July 12-18., 1909, (Bradley).
349. *Pipiza albipilosa* Will. Ottawa, Ont., July 3, (Germain).
350. *Pipiza calcarata* Loew. Vineland, Ont., May and June, (Ross).
350. *Pipiza femoralis* Loew. Toronto, Ont., June 6, 1914, (Walker); Vineland, Ont., May and June, (Ross and Curran).
350. *Pipiza pistica* Will. Vineland, Ont., July 10, (Ross and Curran).
350. *Pipiza pisticoides* Will. Vineland, Ont., May 11, (Ross and Curran).
350. *Pipiza pulchella* Will. Ottawa, Ont., July 3, (Germain).
Eumerus strigatus Fall. Victoria, B.C., reared from Narcissus bulbs, April 7-9, 1910, (E. A. Wallace).
351. *Paragus angustifrons* Loew. Revelstoke, B.C., July 1, 1905, (J. C. Bradley).

351. *Paragus tibialis* Fall. Vineland, Ont., July 17-Aug. 6; also reared from larvæ feeding on *Aphis gossypii*, (Ross and Curran).
352. *Chilosia lasiophthalmus* Will. Carbonate to Prairie Hills, Selkirk Mts., B.C., July 12-18, 1908, (J. C. Bradley); Wellington, B.C., April 16, 1903, (R. V. Harvey).
353. *Chilosia tristis* Loew. Carbonate on Columbia River, July 7-12, 1908, (J. C. Bradley).
359. *Pyrophæna rosarum* Fabr. Ottawa, Ont., June 27, (Germain).
359. *Platychirus peltatus* Meigen. Carbonate to Prairie Hills, Selkirk Mts., July 12-18, 1908, (J. C. Bradley).
359. *Platychirus hyperboreus* Stæger. Vineland, Ont., (Ross and Curran), Bowmanville, Ont., (Ross).
360. *Melanostoma obscurum* Say. Vineland, Ont., May and June, (Ross and Curran).
362. *Leucozona lucorum* Linné. Metlakatla, B.C., (Keen).
362. *Didea fasciata* Macq. Vineland, Ont., May 10, (Ross and Curran).
362. *Didea fasciata* var. *fuscipes* Loew. Carbonate, B.C., July 7-12, 1908, (J. C. Bradley); Macnab's Island, Halifax, N.S., July 4, 1914, (Perrin).
363. *Didea laxa* O. S. Halifax, N.S., June 27, (Perrin).
364. *Syrphus amalopis* O. S. Banff, Alta., June 24, 1911, (Sanson).
365. *Syrphus geniculatus* Macq. Spruce Brook, Nfd., July 29, 1914, (Walker); Ground Hog Basin, Bend Country, Selkirk Mts., B.C., Aug. 4, 1905, (J. C. Bradley); Ottawa, Ont., May 3, (Germain).
366. *Syrphus grossulariæ* Meigen. Carbonate, Columbia River, B.C., July 7-12, 1908, (J. C. Bradley).
367. *Syrphus opinator* O. S. Ground Hog Basin, Selkirk Mts., Aug. 4, 1905, (J. C. Bradley).
Syrphus perplexus Osb. Toronto, Ont., May 30, 1909, (M. C. VanDuzee).
368. *Syrphus torvus* O. S. Spruce Brook, Nfd., July 27, 1914, (Walker).
368. *Syrphus umbellatarum* Fabr. Spruce Brook, Nfd., July 27, 1914, (Walker).
368. *Syrphus velutinus* Will. Ground Hog Basin, Big Bend Country, Selkirk Mts., B.C., July 24, 1905, (J. C. Bradley).
368. *Syrphus xanthostoma* Will. Vineland, Ont., May 17, (Ross and Curran).
371. *Xanthogramma polita* Say. Vineland, Ont., Sept. 8, (Ross and Curran).
373. *Sphærophoria scripta* L. Ottawa, Ont., April 20, (Germain). Mr. C. W. Johnson, when naming this specimen, stated: "This is the true *S. scripta;* although long recorded from America, I have not seen it before."
374. *Sphegina campanulata* Rob. Vineland, Ont., July 9, (Ross and Curran).
374. *Sphegina infuscata* Loew. Ground Hog Basin, Selkirk Mts., B.C., Aug. 4, 1905, July 24, 1908; Carbonate, Columbia River, B.C., July 7-12, 1908, (J. C. Bradley).
374. *Sphegina lobata* Loew. Ground Hog Basin, B.C., July 24, 1905, Aug. 4, 1905, (J. C. Bradley).
375. *Neoascia distincta* Will. Ottawa, Ont., May 13, (Germain).
375. *Neoascia globosa* Walk. Carbonate, B.C., July 7-12, 1908, (J. C. Bradley).
378. *Volucella esuriens mexicana* Macq. Victoria, B.C., April 15, 1905, (Hanham).
378. *Volucella fascialis* Will. Midnapore, Alta., June 15, (Tams); Revelstoke, B.C., June 30, 1914, (Sladen).

382. *Sericomyia chalcopyga* Loew. Spruce Brook, Nfd., June 29, 1914, (Walker).

383. *Arctophila flagrans* O. S. Rogers Pass, B.C., Aug. 1, 1908; Ground Hog Basin, B.C., July 22-Aug. 7, 1905, (J. C. Bradley); Vernon, B.C., (Ruhmann).

Eristalis arbustorum L. Ottawa, Ont., May 5, (Germain). St. John, N.B., (G. P. Engelhardt); Labrador, Battle Harbor, (G. P. Engelhardt). A European species. Jour. N.Y. Ent. Soc. XXIII, 143.

385. *Eristalis compactus* Walk. Halifax, N.S., July 11, (Perrin).

386. *Eristalis flavipes* Walk. Vineland, Ont., April 27, Sept. 16, (Ross and Curran).

386. *Eristalis hirtus* Loew. Agassiz, B.C., July, (Treherne).

386. *Eristalis inornatus* Loew. Mt. Cheam, B.C., July 22, (Treherne).

387. *Eristalis montanus* Will. Leduc, Alta., (J. Fletcher).

Eristalis nemorum, L. Vernon, B.C., Aug. 31, 1904, (R. V. Harvey); Kaslo, B.C., July 11; Revelstoke, B.C., July 14, (R. C. Osburn); Kaslo, B.C., May 7, 1910, (Cockle); Montreal, Que., Sept. 1, 1905, (Beaulieu). A European species—Jour. N.Y. Ent. Soc., XXIII, 144.

Eristalis rupium Fab. Atlin, B.C., (Anderson). A European species—Jour. N.Y. Ent. Soc., XXIII, 143.

393. *Helophilus hamatus* Loew. Aweme, Man., Aug. 25, (J. Fletcher); Vineland, Ont., Aug. 18, (Ross and Curran).

393. *Heliophilus lætus* Loew. Carlsbad Springs, Ont., June 1, 1903, (Gibson); Vineland, Ont., June 6, (Ross and Curran).

393. *Heliophilus latifrons* Loew. Vineland, Ont., Aug. 28 to mid-October, (Ross and Curran).

396. *Triodonta curvipes* Wied. Quebec, Que., (Roy). New to Quebec Province.

398. *Xylota angustiventris* Loew. Vineland, Ont., July 13, (Ross and Curran).

398. *Xylota anthreas* Walk. Vineland, Ont., June 14, July 2, (Ross and Curran.

398. *Xylota barbata* Loew. Kaslo, B.C., May 21, (Cockle).

398. *Xylota chalybea* Wied. Vineland, Ont., June 24, 29, (Ross and Curran).

398. *Xylota curvipes* Loew. Vineland, Ont., June 12, (Ross and Curran). Recorded from Ottawa.

399. *Xylota notha* Will. Vineland, Ont., June 24, (Ross and Curran).

Xylota segnis L. Macnab's Island, Halifax, N.S., July 4, 1914, (Perrin). A European species not heretofore reported from North America. See Verrall, British Flies, VIII, 598, for description and figure, (J. M. A.).

400. *Xylota vecors* O. S. Spruce Brook, Nfd., July 29, 1914, (Walker).

401. *Crioprora cyanella* O. S. Kaslo,, B.C., (July 20, (Cockle).

402. *Criorhina intersistens* Walk. Ground Hog Basin, B.C., July 24, 1905, (J. C. Bradley).

403. *Criorhina scitula* Will. Ground Hog Basin, B.C., Aug. 4, 1905, (J. C. Bradley).

403. *Criorhina umbratilis* Will. Spruce Brook, Nfd., July 28, 1914, (Walker).

404. *Spilomyia fusca* Loew. Ottawa, Ont., Aug. 1, 1906, (J. Fletcher).

404. *Spilomyia interrupta* Will. Similkameen, B.C., Sept. 12, 1913, (Wilson).

404. *Sphecomyia brevicornis* O. S. Duncan, B.C., May 10, 1908, (Hanham).

Sphecomyia occidentalis Osb. Ground Hog Basin, B.C., July 22-Aug. 7,

1905, (J. C. Bradley). Only specimen known, I understand, except unique type.

405. *Temnostoma æqualis* Loew. Spruce Brook, Nfd., June 29, 1911. (Walker).

Conopidæ.

409. *Physocephala tibialis* Say. De Grassi Point, Lake Simcoe, Ont., July 11, 1895, (Walker).
412. *Oncomyia loraria* Loew. Ottawa, Ont., July 28, (Germain); Jordon, Ont., July 9, 1914, (Ross).
412. *Myopa clausa* Loew. Halifax, N.S., July 26, (Perrin).
412. *Myopa vesiculosa* Say. Ottawa, Ont., May 20, 1915, (Germain).

Œstridæ.

419. *Cuterebra scutellaris* Brauer. Peachland, B.C., July, 1902, (A. H. Huston).

Tachinidæ.

423. *Phorantha occidentis* Walk. Aweme, Man., July 6, 13, (N. Criddle); Ottawa, Ont., June 3, (Germain).
424. *Alophora pulverea* Coq. Ottawa, Ont., June, (Germain).
433. *Hypostena flaveola* Coq. Simcoe, Ont., (Caesar).
434. *Hypostena floridensis* Tns. Ottawa, Ont., July 10, 1914. (Beaulieu).
442. *Besseria brevipennis* Loew. Lethbridge, Alta., June 26, 1914, (Strickland).
451. *Ocyptera carolinæ* Desv. De Grassi Point, Lake Simcoe, Ont., July 19, 1895; Toronto, Ont., June 13, 1895, (Walker).
451. *Ocyptera dosiades* Walk. Jordon, Ont., July 28, 1914, (Ross); Prince Albert, Sask.; June 23, 1913, (Walker).
453. *Gymnochæta alcedo* Loew. Vernon, B.C., (Ruhmann).
458. *Exorista nigripalpis* Tns. Pincher, Alta., July 18, 1913, (Strickland).
482. *Microphthalma disjuncta* Wied. Aweme, Man., July 10-21, (N. Criddle).
Trixosceles fumipennis Mall. Aweme, Man., July 23, (N. Criddle).
460. *Phorocera doryphoræ* Riley. Grimsby and Vineland, Ont., (Caesar).
Dichætoneura leucoptera Jns. Simcoe and Guelph, Ont., reared from *Archips cerasivorana*, July 22-Aug. 12, 1912, (Caesar).
484. *Peleteria ænea* Stæger. Pincher, Alta., July 18, 1913, (Strickland).
488. *Echinomyia dakotensis* Tns. Vernon, B.C., (Ruhmann).
* *Saskatchewania canadensis* Smith. Farewell Creek, Sask., June, Aug. and Sept., 1907; Can. Ent., XLVII, 153.

Sarcophagidæ.

510. *Sarcophaga assidua* Walk. Ottawa, Ont., Aug., 1915, (Germain).
511. *Sarcophaga cimbicis* Tns. Ottawa, Ont., Aug. 14, 1912, (Beaulne); Regina, Sask., June 12, 1903, (Willing); Guelph, Ont., (Sanders); Port Hope, May 30, 1907, (W. Metcalfe).
Sarcophaga hæmorrhoidalis Mg. Ottawa, Ont., Sept. 4, 1908, (H. Groh).
512. *Sarcophaga helicis* Tns. Ottawa, Ont., June 30, 1912, (Beaulne).
Agria affinis Fall. Victoria, B.C., reared from *Vanessa antiopa*, (J. R. Anderson).

Miltogrammidæ.

Arabiopsis cocklei Tns. London Hill Mine, Bear Lake, B.C., July 21, 1903, (Cockle); Can. Ent. XLVII, 285.

Salmaciidæ.

* *Knabia hirsuta* Tns. Oxbow, Sask., April 30, May 13, 1907, (F. Knab); Can. Ent. XLVII, 287.

Larvævoridæ.

* *Okanagania hirta* Tns. Okanagan Falls, B.C., April 27, 1913, (E. M. Anderson); Can. Ent., XLVII, 290.
* *Panzeriopsis curriei* Tns. London Hill Mine, Bear Lake, B.C., July 21-29, 1913, (R. P. Currie); Can. Ent., XLVII, 291.
* *Rhachogaster kermodei* Tns. Penticton, B.C., July 4, 8, 1913, (E. M. Anderson); Can. Ent. XLVII, 291.

Mintholdæ.

* *Pseudodidyma pullula* Tns. Victoria, B.C., April 2, 1906, (E. M. Anderson); Can. Ent., XLVII, 288.
518. *Cynomyia cadaverina* Desv. Vernon, B.C., (Ruhmann).
527. *Mesembrina latreillei* Desv. Agassiz, B.C., July, 1915, (Treherne).
Hypodermodes solitaria Knab. Agassiz, B.C., Aug., (Treherne). Described in Can. Ent., Sept., 1910, from Alberta and Montana.

Anthomyidæ.

539. *Fannia serena* Fall. Ottawa, Ont., June 27, (Germain).
547. *Limnophora diaphana* Wied. Ottawa, Ont., June 3, (Germain).
550. *Anthomyia pluvialis* L. Ottawa, Ont., May 13, (Germain).
552. *Hylemyia lipsia* Walk. Ottawa, Ont., May 3, (Germain).
553. *Eustalomyia vittipes* Zett. Ottawa, Ont., July 14, (Germain).
557. *Phorbia latipennis* Zett. Lake Athabaska, near mouth of Charlot River, Northern Saskatchewan, June 29, 1914, (F. Harper).
558. *Pegomyia calyptrata* Zett. Ottawa, Ont., May 13, (Germain).
563. *Schœnomyza dorsalis* Loew. Aweme, Man., Sept. 18-21, (N. Criddle).

Scatophagidæ.

565. *Cordylura adusta* Loew. Ottawa, Ont., April 27, (Germain).
566. *Cordylura volucricaput* Walk. Ottawa, Ont., June 18, (Germain).
566. *Parallelomma varipes* Walk. De Grassi Point, Lake Simcoe, Ont., July 10, 1895, (Walker).
567. *Hydromyza confluens* Loew. Ottawa, Ont., June 15, (Germain).

Heteroneuridæ.

Clusia czernyi Jns. Ottawa, Ont., July 12, (Germain).

Helomyzidæ.

572. *Helomyza longipennis* Loew. Spruce Brook, Nfd., July 28, 1914, (Walker).
572. *Anorostoma marginata* Loew. Ottawa, Ont., June 27, (Germain).
572. *Scoliocentra helvola* Loew. Ottawa, Ont., July 14, (Germain).

Sciomyzidæ.

578. *Sciomyza pubera* Loew. Ottawa, Ont., July 14, (Germain).
578. *Neuroctena anilis* Fall. Ottawa, Ont., June 3, (Germain).
580. *Tetanocera valida* Loew. De Grassi Point, Lake Simcoe, Ont., Aug. 26, 1914, (Walker).
581. *Sepedon fuscipennis* Loew. Spruce Brook, Nfd., July 29, 1914, (Walker).
581. *Sepedon pusillus* Loew. De Grassi Point, Lake Simcoe, Ont., Aug. 26, 1914, (Walker).

Sapromyzidæ.

Lonchæa laticornis Mg. Banff, Alta., Aug. 29, 1911, (Sanson).
582. *Lonchæa rufitarsis* Macq. Toronto, Ont., May 13, 1914, (Walker).
582. *Palloptera jucunda* Loew. Inverness, B.C., July, 1910, (J. H. Keen).
582. *Palloptera superba* Loew. Ottawa, Ont., June 21, 1904, (W. Metcalfe).
585. *Sapromyza decora* Loew. Ottawa, Ont., Aug. 11, 1909, (W. Metcalfe).
587. *Sapromyza vulgaris* Fitch. Ottawa, Ont., June, (Germain); Aweme, Man., July 13, (N. Criddle).

Ortalidæ.

587. *Pyrgota chagnoni* Jns. Ottawa, Ont., May 16, (Germain).
589. *Rivellia flavimanus* Loew. Toronto, Ont., May 30, 1896; June 6, 1914. (Walker).
589. *Rivellia viridulans* Desv. Toronto, Ont., June 19, 1895; Dauphin, Man., June 22, 1913, (Walker).
592. *Tephronota narytia* Walk. Aweme, Man., July 23, (N. Criddle).
597. *Chætopsis massyla* Walk. Aweme, Man., Sept. 7, (N. Criddle).

Trypetidæ.

603. *Acidia fratria* Loew. Toronto, Ont., June 8, 1914, (Walker).
604. *Spilographa electa* Say. Smith's Cove, N.S., July 15, 1914, (Gibson).
604. *Spilographa setosa* Doane. Reared from hips of *Rosa nutkana* collected at Cowichan Lake, B.C., Sept. 18, 1906, by J. Fletcher; emerged at Ottawa, Ont., June 25, 1907, (Gibson).
605. *Trypeta occidentalis* Snow. Larvæ destroying seeds of *Cirsium drummondii* at Elphinstone, Man., collected by W. A. Burman; adults reared, (Gibson).
Rhagoletis fausta O. S. Victoria B.C., June 19, 1907, (R. M. Palmer).
607. *Rhagoletis rubicola* Doane. Aweme, Man., July 3, (J. Fletcher and N. Criddle).
611. *Tephritis albiceps* Loew. Ottawa, Ont., July 1, 1914, (Beaulne).
611. *Tephrites clathrata* Loew. Aweme, Man., Sept. 18, (N. Criddle).
613. *Urellia aldrichii* Doane. Aweme, Man., Oct. 4, (N. Criddle).

Micropezidæ.

616. *Calobata alesia* Walk. Ottawa, Ont., June 27, (Germain).
616. *Calobata antennipes* Say. Toronto, Ont., June 13, 1895, (Walker).
617. *Calobata univitta* Walk. Ottawa, Ont., June 15, (Germain); Toronto, Ont., June 11, 1914, (Walker).

Psillidæ.

621. *Loxocera collaris* Loew. Ottawa, Ont., June 20, (Germain).

Ephydridæ.

623. *Dichæta caudata* Fall. Ottawa, Ont., June 3, (Germain).
623. *Notiphila bella* Loew. Ottawa, Ont., May 27, (Germain).
623. *Notiphila carinata* Loew. Toronto, Ont., June 13, 1914, (Walker).
Psilopa compta Mg. Aweme, Man., Oct. 14, (N. Criddle).
627. *Hydrellia obscuriceps* Loew. Brockville, Ont., Sept. 20, 1903, (W. Metcalfe); Ottawa, Ont., Aug. 28, 1908, (J. Fletcher).
627. *Philygria opposita* Loew. Ottawa, Ont., July 28, (Germain); Aweme, Man., July 23, (N. Criddle).
628. *Ochthera mantis* DeG. Lake McGregor, Que., July 12, (Germain). New to Quebec Province.
628. *Pelina truncatula* Loew. Aweme, Man., Oct. 17, (N. Criddle).
629. *Parydra bituberculata* Loew. Ottawa, Ont., July 3, (Germain); Ottawa, July 21, Aug. 6, 1914, (Beaulieu); Toronto, Ont., June 13, 1914, (Walker).
629. *Ephydra atrovirens* Loew. Ottawa, Ont., June, July, (Germain).
630. *Scatella oscitans* Walk. Aweme, Man., Oct. 14, (N. Criddle).
630. *Scatella stagnalis* Fall. Bridgetown, N.S., Aug. 29, 1912, (Sanders); Port Hope, Ont., May 24, 1897, (Metcalfe); Aweme, Man., Sept. 7, Oct. 14, 17, (N. Criddle).

Oscinidæ.

Meromyza flavipalpis Mall. Aweme, Man., July 20, (N. Criddle).
Meromyza marginata Beck. Beaver River, Alta., Aug. 20, (Strickland).
632. *Anthracophaga maculosa* Loew. Montreal, Que. Record from Becker's Mon. of Chloropidæ IV, 1912, p. 44.
632. *Anthracophaga eucera* Loew. Brockville, Ont., Aug. 23, 1903, (Metcalfe); Bridgetown, N.S., Aug. 29, (Sanders).
Chlorops seminigra Becker. Type locality, Montreal, Que. Described in Becker's Monograph of Chloropidæ, IV, 66, 1912.
633. *Diplotoxa microcera* Loew. Aweme, Man., July 2, (N. Criddle).
633. *Diplotoxa versicolor* Loew. Aweme, Man., June 25, (N. Criddle).
Chlorops stigmata Becker. Type locality, Vancouver Island, B.C., (Livingston). Described in Becker's Monograph of Chloropidæ, IV, 60, 1912.
Chlorops integra Becker. Aweme, Man., July 20, Aug. 8, (N. Criddle).
Chlorops rufescens Coq. Ottawa, Ont., July 4, (Beaulne).
Chloropisca clypeata Mall. Regina, Sask., June 18, 1904, (J. Fletcher): Ottawa, Ont., June 24, 1904, (W. Metcalfe).
633. *Chloropisca obscuricornis* Loew. Aweme, Man., July 23, (N. Criddle).
Chloropisca obtusa Mall. Ottawa, Ont., July 17, 1904, (W. Metcalfe).
634. *Chloropisca variceps* Loew. Athabaska, Alta., Edmonton, Alta., Aug. 10, (Strickland); Prince Albert, Sask., July 28, 1907, (J. Fletcher).
635. *Eurina exilis* Coq. De Grassi Point, Lake Simcoe, Ont., Aug. 26, 1914, (Walker).
635. *Hippelates flavipes* Loew. Aweme, Man., Sept. 16, (N. Criddle).
Hippelates pallipes Loew. Aweme, Man., June 12, (N. Criddle).

636. *Elachiptera costata* Loew. Ottawa, Ont., May 27, 1905; Chelsea, Que., May 27, 1905; Carlsbad Springs, Ont., June 26, (W. Metcalfe).
638. *Elachiptera decipiens* Loew. Aweme, Man., Oct. 17, (N. Criddle).
636. *Elachiptera longula* Loew. Aweme, Man., July 6, (N. Criddle).
Mosillus subsultans Fab. Aweme, Man., Aug., Sept., (N. Criddle).
637. *Siphonella oscinina* Fall. Brockville, Ont., Sept. 13, 1903, (W. Metcalfe).
Siphonella parva Ad. Aweme, Man., June 12, (N. Criddle); Ottawa, Aug. 26, 1908, (Fletcher).
638. *Oscinis dorsata* Loew. Aweme, Man., June 6, July 23, Aug. 6, Sept. 7, (N. Criddle).
Oscinis marginalis Mall. Aweme, Man., Aug. 6, (N. Criddle).
Oscinis melanchulica Beck. Aweme, Man., July 23, (N. Criddle).
639. *Oscinis trigramma* Loew. Aweme, Man., Sept. 7, 21, Oct. 10., (N. Criddle).
639. *Oscinis umbrosa* Loew. Aweme, Man., July 13, 23, (N. Criddle).

Drosophilidæ.

641. *Drosophila amœna* Loew. Brockville, Ont., Aug. 12, 1903, (Metcalfe); Ottawa, Ont., June 2, 1878, (Fletcher).

Agromyzidæ.

Phytomyza acuticornis Loew. Aweme, Man., July 13, (N. Criddle).
Phytomyza flava Fall. Aweme, Man., Oct. 12, (N. Criddle).
Cerodonta femoralis Mg. Aweme, Man., Oct. 9-17, (N. Criddle).
647. *Agromyza angulata* Loew. Aweme, Man., Aug. 6, (N. Criddle).
Agromyza coquilletti Mall. Aweme, Man., June 25, (N. Criddle).
Agromyza genualis Mel. Aweme, Man., Oct. 9, (N. Criddle).
648. *Agromyza jucunda* Van der Wulp. Aweme, Man., Oct. 10, (N. Criddle).
Agromyza immaculata Coq. Brockville, Ont., Oct. 25, 1903, (W. Metcalfe); Aweme, Man., Oct. 14, (N. Criddle).
Agromyza laterella Zett. Brockville, Ont., Sept. 13, 1903, (W. Metcalfe).
648. *Agromyza marginata* Loew. Ottawa, Ont., Sept. 1, 1908, (Fletcher); Aylmer, Que., Oct. 20, 1905, (W. Metcalfe). New to Quebec Province.
Agromyza nasuta Mel. Aweme, Man., July 6, (N. Criddle); Montreal, Que., July 11, 1914, (Winn); Port Hope, Ont., May 24, 1897, (W. Metcalfe); Ottawa, Ont., Aug. 26, 1908, (J. Fletcher).
Agromyza scutellata Fall. Aweme, Man., July 20; June 25, (N. Criddle).
649. *Agromyza terminalis* Coq. Dauphin, Man., June 22, 1913, (Walker).
649. *Agromyza vireus* Loew. Ottawa, Ont., Aug. 17, 1907, (J. Fletcher); Brockville, Ont., Aug. 23, 1903, (W. Metcalfe).
Meoneura vagans Fall. Aweme, Man., July 23, (N. Criddle).
649. *Desmometopa latipes* Mg. Aweme, Man., July 6, (N. Criddle).
649. *Desmometopa m-nigrum* Zett. Brockville, Ont., Sept. 20, 1903, (W. Metcalfe).
Desmometopa sordida Fall. Ottawa, Ont., June 1, 1900, (Gibson).
651. *Milichia arcuata* Loew. Ridgeway, Ont., July 23, 1910, (Walker).
Pseudodinia pruinosa Mel. Aweme, Man., Aug. 6, (N. Criddle).
652. *Ochthiphila elegans* Panz. Carlsbad Springs, Ont., June 26, 1904, (W. Metcalfe).
652. *Ochthiphila polystigma* Mg. Aweme, Man., Aug. 6, (N. Criddle).

Hymenoptera.

During the year 1915, many specimens in this order were collected in the various provinces in Canada, and some of the interesting captures are here recorded. Species collected in former years have been definitely determined, and some of these, too, we are now able to include. The records of these give further information on their distribution within the Dominion.

Tenthredinidæ.

Strongylogastroidea aprilis Say. Toronto, Ont., June 13, 1895, (Walker).
Parasiobla rufocinctus Nort. Toronto, Ont., June 13, 1895, (Walker).
Dolerus aprilis Nort. Toronto, Ont., June 19, 1907; May 5, 1914, (Walker).
Dolerus cohæsus MacG. Ottawa, Ont., July, 1914, (Germain); Spruce Brook, Nfd., July 27, 1914, (Walker).
Dolerus stugnus MacG. Ottawa, Ont., July, 1914, (Germain).
Dolerus unicolor Beauv. Toronto, Ont., April 19, 1895, (Walker).
Loderus apricus (Nort). Ottawa, Ont., July, 1914, (Germain); Toronto, Ont., June 13, 1914, (Walker).
Tenthredo basilaris Say. De Grassi Point, Lake Simcoe, Ont., Aug. 22, 1914, (Walker).
Macrophya trisyllaba Nort. Toronto, Ont., May 24, 1889, (E. M. Morris); Spruce Brook, Nfd., July 27, 1914, (Walker); Pictou, N.S., July 22, 1914, (Walker).
Cimbex laportei Lep. Dauphin, Man., June 23, 1913, (Walker).
Cimbex 10-maculata Urban. Prince Albert, Sask., June 26, 1913, (Walker).
Gymnonychus appendiculatus Hart. Ottawa, Ont., June 13, 1914, (Germain).
* *Euura cosensii* Rohwer. Toronto, Ont., (Cosens). Proc. U. S. N. M., Vol. 49, 213.
Amauronematus semirufus (Kirby). Ottawa, Ont., Aug. 3, 1913, (Germain).
Pachynematus extensicornis Nort. Ottawa, Ont., Aug. 7, 1914, (Germain); De Grassi Pt., Lake Simcoe, Ont., Aug. 23, 1914, (Walker).
Pristiphora bivittata Nort. Ottawa, Ont., May 22, 1914, (Germain).
Monophadnoides concessus MacG. Ottawa, Ont., Aug. 25, 1914, (Germain).

Cynipidæ.

Callirhytis gemmarius Ash. On island near Hamill's Point, Lake Joseph, Muskoka, Ont., (Cosens). First Canadian record (W. B.).
Andricus clavula O. S. On island near Hamill's Point, Lake Joseph, Muskoka, Ont., (Cosens). First Canadian record (W. B.).
Andricus piger Bass. On island near Hamill's Point, Lake Joseph, Muskoka, Ont., (Cosens). First Canadian record (W. B.).
Andricus ventricosus Bass. On island near Hamill's Point, Lake Joseph, Muskoka, Ont., (Cosens). First Canadian record (W. B.).
* *Diastrophus fragariæ* Beut. Toronto, Ont., (Cosens). Can. Ent., XLVII, 353.

Braconidæ.

Meteorus loxostege Vier. Iron Springs, Alta., May 18, 1914, (Strickland).
Sigalphus bicolor Cr. Grimsby Ont., June 20, 1914, (Walker).
Spathius canadensis Ashm. Toronto, Ont., May 26, 1895, (Walker).

Ichneumonidæ.

Crematus retiniæ Cr. Toronto, Ont., June 13, 1914, (Walker).
Campoplex expertus Cr. Toronto, Ont., June 7-11, 1914, (Walker).
Campoplex vitticollis Nort. Toronto, Ont., June 11, 1914, (Walker).
Thyreodon morio Fab. De Grassi Point, Lake Simcoe, Ont., Aug. 16, 1914, (Walker).
Exochus pallipes Cr. Toronto, Ont., July 12, 1914, (Walker).
Spanotecnus concolor Cr. Toronto, Ont., June 13, 1914, (Walker).
Spanotecnus discolor Cr. St. Catharines, Ont., June 21, 1914, (Walker).
Odontomerus mellipes Say. Toronto, Ont., (Walker).
Megarhyssa nortoni Cr. Pictou, N.S., July 22, 1914, (Walker).
Rhyssa persuasoria Linn. Quebec, Que., (Roy).
Rhyssa albomaculata Cr. Spruce Brook, Nfd., July 29, 1914, (Walker); Edmonton, Alta., (Carr).
* *Pseudorhyssa sternata* Merrill. Toronto, Ont., Aug. 20, 1892. Trans. Amer. Ent. Soc., XLI, 150.
Lissonota superba Prov. Edmonton, Alta., May 22, 1911, (Carr).
Arenetra canadensis Cr. Macleod, Alta., July, 1913, (Strickland).
Lampronota parva Cr. Toronto, Ont., April 19, 1895, (Walker).
Arotes vicinus Cr. Morris Island, Muskoka, Ont., July 30, 1888 (E. M. Morris).
Coleocentrus occidentalis Cr. Departure Bay, B.C., July 5, 1913, (Walker).
Cryptus robustus Cr. De Grassi Point, Lake Simcoe, Ont., Aug. 16, 1914. (Walker).
Ichneumon bimembris Prov. Prince Albert, Sask., (Walker).
Ichneumon canadensis Cr. Spruce Brook, Nfd., July 29, 1914, (Walker); Departure Bay, B.C., July 6, 1913, (Walker).
Ichneumon comes Cr. Morris Island, Muskoka, Ont., July 8, 1888, (E. M. Morris).
Ichneumon cincticornis Cr. Edmonton, Alta., Nov. 10, 1910, (Carr); Prince Albert, Sask., June 26, 1913, (Walker); Toronto, Ont., Aug 8, 1914, (Walker).
Ichneumon cæruleus Cr. Muskoka, Ont., July 30, 1888, (E. M. Morris).
Ichneumon devinctor Say. Edmonton, Alta., April 23, 1910, (Carr).
Ichneumon funestus Cr. Toronto, Ont., Aug. 8, 1914, (Walker).
Ichneumon feralis Cr. Spruce Brook, Nfd., July 27, 1914, (Walker); Edmonton, Alta., (Carr).
Ichneumon flavicornis Cr. Departure Bay, B.C., July 4, 1913, (Walker).
Ichneumon galenus Cr. Toronto, Ont., Aug. 8, 1914, (Walker).
Ichneumon grandis Br. Departure Bay, B.C., July 29, 1913, (Walker).
Ichneumon orpheus Cr. De Grassi Point, Lake Simcoe, Ont., Aug. 16, 1914, (Walker).
Ichneumon pervagus Cr. Morris Island, Muskoka, Ont., (E. M. Morris).
Ichneumon putus Cr. Edmonton, Alta., (Carr).
Ichneumon seminiger Cr. Toronto, Ont., April 12, 1895, (Walker).

Ichneumon suadus Cr. Lake Simcoe, Ont., (Walker).

Ichneumon sublatus Cr. Hamilton, Ont., June 20, 1911, (Walker).

* *Coelichneumon barnstoni* Morley. Hudson Bay, 1884, (Geo. Barnston); Revision of the Ichneumonidæ in the British Museum, Part IV, p. 130.

Amblyteles montanus Cr. Sault Ste. Marie, Ont., June 10, (E. M. Morris).

Amblyteles quebecensis Prov. Departure Bay, B.C., July 7, 1913, (Walker).

Amblyteles stadaconensis Prov. De Grassi Point, Lake Simcoe, (Walker).

Amblyteles subrufus Cr. Sault Ste. Marie, Ont., June 7, 1889, (E. M. Morris).

Amblyteles suturalis Cr. Lethbridge, Alta., July 23, 1914, (Strickland).

Amblyteles tetricus Prov. Toronto, Ont., (Walker).

Trogus fulvipes Cr. Okanagan Landing, B.C., Aug. 16, 1913, (Walker).

Trogus obsidianator Br. De Grassi Point, Lake Simcoe, Ont., Aug. 6, 1895, (Walker).

* *Xenoschensis gracilis* Cushman. Banff, Alta. Proc. Ent. Soc. Wash., XVII, 141.

* *Xenoschensis slossonæ* Cushman. Spruce Brook, Nfd., July 21, 1914, (Walker); Proc. Ent. Soc. Wash., XVII, 140.

Eulophidæ.

Tetrastichus asparagi Cwfd. Vineland, Ont., (Ross).

Formicidæ.

Lasius niger L. var *sitkaensis* Pergande. Treesbank, Man., Sept. 23, (Hewitt).

* *Formica fusca* L. var *algida* Wheeler. Kenora, Ont., (J. C. Bradley); Saguenay River, Que., (Geo. Englehardt); Digby, N.S., (J. Russell); also from Newfoundland and Labrador; Psyche, XXII, 205.

Formica neogagates Em., subsp. *vetula* Wheeler. Banff, Alta., Sept. 16, (Hewitt).

Formica rufa L. subsp. *aggeranus* Wheeler. Banff, Alta., Sept. 16, (Hewitt).

Formica ulkei Em. Treesbank, Man., Sept. 23, (Hewitt).

* *Aphænogaster subterranea borealis* Wheeler. Lardo, Kootenay Lake, B.C., (J. C. Bradley); Bull. Amer. Mus. Nat. Hist., XXXIV, 413.

Psammocharidæ.

* *Ageniella cupidella* Banks. Ridgeway, Ont., Can., July 9, (Van Duzee); Can. Ent., XLVII, 400.

Apidæ.

Osmia armaticeps Cr. Invermere, B.C., female, June 30, 1914, (Sladen); Okanagan Landing, B.C., April 23, 1914, (Wilson).

Osmia quadridentata Cr. Hull, Que., April 25, (Sladen); Toronto, Ont., April 19, 1896, (W. Brodie).

Osmia bucephala Cr. Banff, Alta., May 21, (Sladen); Toronto, Ont., May 6, 1894, (W. Brodie).

Osmia cærulescens Linn. Ottawa, Ont., May and June, (Sladen); Toronto, Ont., June and July, (W. Brodie). Mr. Sladen considers *purpurea* Cr. to be the same insect known in England as *cærulescens*.

Osmia lignaria Say. Ottawa, Ont., male, April 5, 23, (Sladen); Golden, Invermere and Sydney, B.C.; Banff, Alta., (Sladen).

Osmia coloradensis Cr. Spulamacheen, B.C., female, Aug., (Wilson); Shawnigan, B.C., July; Revelstoke, B.C., May; Invermere, B.C., May, (Sladen).

Bombus fervidus Fabr. Vernon, B.C., (Venables).

Bombus moderatus Cr. Banff, Alta., (Sanson); Banff, Alta., on *Arctostaphylos uva-ursi*, May 21, (Sladen).

Psithyrus latitarsus Morrill. Aweme, Man., Sept. 16, (N. Criddle).

Hemiptera-Heteroptera.

(Arranged according to Banks' Catalogue; Amer. Ent. Soc., 1910; the numbers refer to the pages in the catalogue.)

Saldidæ.

12. *Salda humilis* Say. Ottawa, Ont., May and June, 1913 and 1914, (Germain).

12. *Salda littoralis* Linn. Ottawa, Ont., May and June, 1913 and 1914, (Germain).

Reduviidæ.

16. *Zelus luridus* Stal. Bondville, Que., (Moore).

Nabidæ.

22. *Reduviolus propinquns* Reut. Bondville, Que., (Moore).

Capsidæ.

30. *Plagiognathus politus* Uhler. Ottawa, Ont., June 27, 1914, (Germain).

37. *Dicyphus vestitus* Uhler. Ottawa, Ont., July 30, 1914, (Germain).

40. *Resthenia insitiva* Say. Aylmer, Que., Aug. 1914, (Germain).

41. *Miris vicina* Prov. Ottawa, Ont., Aug. 23, (Germain).

44. *Horcias marginalis* Reut. Ottawa, Ont., July 20, 1914, (Germain).

46. *Lygus viticollis* Reut. Ottawa, Ont., May 27, 1914, (Germain).

47. *Phytocoris lasiomerus* Reut. Ottawa, Ont., June, 1914, (Germain).

49. *Stenotus binotatus* Fabr. Ottawa, Ont., Aug. 3, 1914, (Germain).

49. *Pœciloscytus basalis* Reut. Ottawa, Ont., Aug., 1914, (Germain).

Tingitidæ.

56. *Galeatus peckhami* Ashm. Ottawa, Ont., Aug. 1914, (Germain).

Lygæidæ.

58. *Ischnodemus falicus* Say. Ottawa, Ont., July 23, 1914, (Germain).

59. *Crophius disconotus* Say. Ottawa, Ont., July 3, 1914, (Germain).

Pentatomidæ.

86. *Menecles insertus* Say. Quebec, Que., (Roy).

Orthoptera.

Some interesting records of these insects have been received. Considerable collecting in the order has recently been accomplished and our knowledge of the distribution of many of the species considerably widened.

Mantidæ.

Mantis religiosa L. This species known as the European Praying Mantis, and recorded in last year's Entomological Record, has evidently established itself in the Province of Ontario. This year it was again found near Picton, in Hallowell Township, on Oct. 1, (Brimley).

Acridiidæ.

Acrydium obscurum Hanc. Aweme, Man., May 28, Sept. 16, 1915, (Criddle).
Chlöealtis conspersa Harr. Athabaska Landing, Alta., Aug. 11, 1915, (Strickland). Previously reported from Banff, by Walker.
Orphulella speciosa Scudd. Aweme, Man., Aug. 7-17, (E. and N. Criddle).
Chortophaga viridifasciata DeG. Treesbank, Man., June 11, (E. Criddle).
Arphia frigida Scudd. Fort Chipewyan, Alta., June 14, 15, 1914; Fort McMurray, Alta., May 29, 1914, Hill Island Lake, Southern Mackenzie, July 13, 1914, (F. Harper).
Hippiscus tuberculatus Beauv. Fort Chipewyan, Alta., June 15, 1914, (F. Harper).
Trimerotropis monticola Sauss. Aweme, Man., Sept. 16, 1914, (N. Criddle).
Circotettix verruculatus Kirby. Athabaska Landing, Alta., Aug. 11, (Strickland); Island in Tsu Lake, Southern Mackenzie, Aug. 6, 1914; Fort Resolution, Mackenzie, Aug. 24, (F. Harper).
Melanoplus bivittatus Dodge. Athabaska Landing, Alta., Aug. 12, 1915, (Strickland).
Melanoplus bruneri Scudd. Athabaska Landing, Halcourt and Water Hole, Alta., Aug. 11, 12, (Strickland).
Melanoplus fasciatus Walk. Athabaska Landing, Alta., Aug. 11, (Strickland); Fort Resolution, Mackenzie, Aug. 24, 1914, (F. Harper).

Locustidæ.

Scudderia pistillata Brun. Rosedale, Alta., (Miss E. Moodie); St. Louis, Sask., July 25, 1898, (E. Coubeaux); new to Saskatchewan.
Conocephalus fasciatus DeG. Peachland, B.C., Aug. 6, (Wallis).
Udeopsylla nigra Scudd. Oxbow, Sask., July 31, 1897, (W. Noble).

Gryllidæ.

Nemobius fasciatus DeG. Near Souris, P.E.I., Aug. 27, 1915, (A. G. Huntsman).
Œcanthus niveus DeG. Penticton, B.C., Aug. 1908, (Mrs. Fowler).
Œcanthus nigricornis quardipunctatus Beut. Peachland, B.C., Aug. 2-12, (Wallis).

Neuropteroid Insects (Except Odonata).

(Arranged according to a catalogue of the Neuropteroid Insects (except Odonata) of the United States, by Nathan Banks; American Entomological Society, 1907. The numbers refer to the pages of the catalogue.)

Corrodentia.

Psocidæ.

7. *Pterodela pedicularis* L. Spruce Brook, Nfd., July 29, 1914, (Walker).
9. *Psocus campestris* Aaron. Toronto, June 30, 1914, (Walker).
9. *Psocus hageni* Bks. Algonquin Park, Ont., Aug. 17, 1903, (Walker).

Archiptera.

Perlidæ.

10. *Pteronarcys regalis* Newm. Athabaska River, between Grand Rapids and mouth of Little Buffalo River, Alberta, May 24, 25, (F. Harper).
10. *Pteronarcella badia* Hag. Coldwater, B.C., July, 1914, (Wilson).
11. *Isogenus frontalis* Newm. Hymers, Ont., June 19, 1908, (Dawson); Athabaska River, between Grand Rapids and Fort McMurray, Alta., May 28, 1914, (F. Harper); Tazin River, near Tha-inka Lake, Northern Saskatchewan, July 11, (F. Harper).
13. *Isoperla bilineata* Say. Ottawa, Ont., Aug. 13, 1909, (H. Groh); Ottawa, Ont., June 11, 1913, (Beaulne).
13. *Isoperla ebria* Hag. Bartlett Bay, off Glacier Bay, Alaska, June 19, 1907, (D. H. Nelles).
14. *Tæniopteryx frigida* Hag. Hull, Que., May 22, 1904, (W. Metcalfe).
15. *Arsapnia decepta* Banks. Wellington, B.C., March 9, 1907, (G. W. Taylor).

Ephemeridæ.

16. *Ephemera simulans* Walk. Tazin River and Hill Island Lake, Southern Mackenzie, July 14, 1914, (F. Harper).

* *Callibætis semicostata* Banks. Stony Mt., Man., Sept. 16, (Wallis); Proc. Acad. Nat. Sciences, Philadelphia, LXVI, 614.

Neuroptera.

Sialidæ.

22. *Sialis infumata* Newm. Casselman, Ont., May 22, 1904, (J. Fletcher); La Seine River, Rainy River District, Ont., June 30, (W. McInnes).

Trichoptera.

Limnephilidæ.

35. *Neuronia semifasciata* Say. Tsal-wor Lake, about 8 miles north of Lake Athabaska, Northern Saskatchewan, July 5, 1914, (F. Harper).
36. *Glyphotælius hostilis* Hag. Spruce Brook, Nfd., July 29, 1914, (Walker).

Limnephilus bifidus. Lake Athabaska, near mouth of Charlot River, Northern Saskatchewan, June 29, 1914, (F. Harper).

36. *Limnephilus indivisus* Walk. Hamilton, Ont., June 20, 1914, (Walker).
36. *Limnephilus nebulosus* Kirby. Fort Chipewyan, Alta., June 16-18, 1914, (F. Harper).

37. *Anabolia bimaculata* Walk. St. Lawrence River, between Montreal and Quebec (on steamer), July 15-16, 1914, (Walker).
Anabolia nigricula Banks. Fort Resolution, Mackenzie, Aug. 24, 1914, (F. Harper).
38. *Halepsyche indistinctus* Walk. Spruce Brook, Nfd., July 27, 1914, (Walker).
38. *Pycnopsyche guttifer* Walk. De Grassi Pt., Ont., Sept. 22, 1914, (Walker).
39. *Platyphylax designata* Walk. Tazin River, near Tha-inka Lake, Northern Saskatchewan, July 11, 1914, (F. Harper).
40. *Chilostigma difficilis* Walk. Toronto, Nov. 22, 1913, (Walker).

Sericostomatidæ.

42. *Brachycentrus similis* Banks. Athabaska River, above mouth of House River, Alta., May 22, 1914, (F. Harper).

Leptoceridæ.

46. *Leptocella exquisita* Walk. St. Lawrence River near Quebec (on steamer), July 16, 1914, (Walker).
46. *Mystacides sepulchralis* Walk. Sydney, N.S., July 24, 1914; Spruce Brook, Nfd., July 27, 1914, (Walker).
46. *Setodes grandis* Bks. Toronto, June 30, 1914, (Walker).

Hydropsychidæ.

47. *Hydropsyche scalaris* Hag. St. Lawrence River near Quebec (on steamer), July 16, 1914, (Walker).
48. *Nyctiophylax vestitus* Hag. Spruce Brook, Nfd., July 27, 1914, (Walker).

Odonata.

(Arranged according to Muttkowski's Catalogue of the Odonata of North America. The numbers refer to the pages.)

Coenagrionidæ.

39. *Lestes uncatus* Kirby. Red Deer, Alta., 1915 (Whitehouse). New to Alberta.
48. *Argia moesta putrida* Hag. St. John's, Que., July 11, 1914, (Chagnon).
54. *Enallagma antennatum* Say. St. John's, Que., July 11, 1914, (Chagnon). New to Quebec.
56. *Enallagma carunculatum* Morse. St. John's, Que., July 11, 1914, (Chagnon).
59. *Enallagma ebrium* Hag. St. John's, Que., June 24, 1914, (Chagnon).
59. *Enallagma exsulans* Hag. St. John's, Que., July 11, 1914, (Chagnon). New to Quebec.
85. *Ophiogomphus rupinsulensis* Walsh. St. John's Que., June 22, 1914, (Chagnon).
94. *Gomphus intricatus* Hag. Saskatoon, Sask., July 28, 1910, (Willing). First Canadian record. (Determined by P. P. Calvert.)
114. *Aeshna sitchensis* Hag. Red Deer, Alta., 1915 (Whitehouse).
114. *Aeshna umbrosa* Walk. Red Deer, Alta., 1915, (Whitehouse). New to Alberta.

Siphonaptera.

* *Ceratophyllus ignotus recula* J. and R. Okanagan Landing, B.C., July, 1913, off *Putorius arizonensis*, (J. A. Munro); Okanagan Falls, B.C., April, 1913, off *Thomomys talpoides*, (C. Grant); Kelowna, B.C., Dec. 1910, off *Mustela* sp. (A. Tate); Ectoparasites, 1, 58.

* *Ceratophyllus ignotus albertensis* J. and R. Blackfalds, Alta., collected off *Geomys* sp., *Mustela* sp., and *Lynx canadensis*, (A. D. Gregson); Ectoparasites, 1, 56.

* *Megarthroglossus sicamus* J. and R. Eagle River, Sicamous, B.C., found on *Canis latrans*, Sept. 1903, (G. F. Dippie); Ectoparasites, 1, 50.

* *Megarthroglossus procus* J. and R. Chilliwack, B.C.; collected on *Spilogale*, Sept. 1899, and on *Peromyscus*, Dec. 1899, (Allan Brooks); Ectoparasites, 1, 47.

* *Catallagia decipiens* Rothschild. Horse Creek, Upper Columbia Valley, B.C., Oct. 13, 1913, off *Peromyscus*, (G. F. Dippie); Blackfalds, Alta., (A. J. Gregson); Red Deer, Alta., April 25, 1901, off *Evotomys saturatus*, (G. F. Dippie); British Columbia, off *Neotoma cinerea* (W. Wenmann); Ectoparasites, 1, 43.

* *Neopsylla inopina* Rothschild. Calgary, Alta., found on *Spermophilus richardsoni*, April 11, 1907, (C. Garrett); Calgary, Alta., on *Putorius longicaudatus* and *Evotomys saturatus*, (G. F. Dippie); Ectoparasites, 1, 30.

* *Doratopsylla curvata* Rothschild. Blackfalds, Alta., off Kangaroo Mouse and Shrew Mouse, (A. D. Gregson); Ectoparasites, 1, 25.

Araneida.

(Arranged according to Banks' Catalogue of Nearctic Spiders, U. S. N. M., Bulletin 72. The numbers refer to the pages in the catalogue.)

During 1915, collections of spiders have been made in some of the provinces, and also in Labrador, but many of the species have not, as yet, been determined. In 1914, Mr. J. H. Emerton collected in Alberta, and through Mr. N. B. Sanson, of Banff, some of the records are included here. Mr. Sanson has also made collections for several years and recently Mr. Emerton has named these.

Drassidæ.

10\. *Drassus coloradensis* Em. Banff, Alta., July 4, 1914, (Sanson).

10\. *Drassus neglectus* Keys. Natashkwan, South Labrador, July, (C. W. (Townsend).

Clubionidæ.

* *Clubiona obtusa* Em. Banff, Aug., 1914, (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 153.

Agelenidæ.

15\. *Cryphœca montanata* Em. Banff, Alta., Aug. 15, 1914, (J. H. Emerton).

15\. *Hahnia agilis* Keys. Old Romaine, South Labrador, July, (C. W. Townsend).

Theridiidæ.

20. *Theridium sexpunctatum* Em. Lake Louise, Alta., Aug. 1914, (J. H. Emerton).
21. *Steatoda borealis* Hentz. Banff, Alta., Aug. 15, 1914, (J. H. Emerton); South Labrador, July, (C. W. Townsend).
26. *Hypselistes florens* Camb. Colpoy's Bay, Ont., Ompah, Ont., (A. B. Klugh).
 * *Lophocarenum dentipalpis* Em. Goat Mountain, Jasper, Alberta, (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 149.
 * *Lophocarenum erectum* Em. Tackakaw Falls, Yoho Valley, B.C., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 150.
 * *Gongylidium tuberosum* Em. Battle Harbor, Labrador, (C. W. Leng); Trans. Conn. Acad. Sci., Vol. 20, 150.
 * *Gongylidium canaliculatum* Em. Prince Albert, Sask., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 151.
 * *Tmetis reticulatus* Em. Lake Louise, Laggan, Alta., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 148.
 * *Tmetis obtusus* Em. Lake Louise, Laggan, Alta.; Jasper, Alta., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 149.

Linyphiidæ.

33. *Linyphia nearctica* Banks. Blanc Sablon, South Labrador, July, (C. W. (Townsend).
33. *Linyphia phrygiana* Koch. Banff, Alta., Aug. 15, 1914, (J. H. Emerton); South Labrador, July, (C. W. Townsend).
 * *Bathyphantes arborea* Em. Banff, Alta.; Laggan, Alta.; Yoho Valley, B.C., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 150.
 * *Bathyphantes occidentalis* Em. Vancouver, B.C., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 151.
 * *Microneta pinnata* Em. Prince Albert, Sask., (J. H. Emerton); Trans. Conn. Acad. Sc., Vol. 20, 152.
 * *Microneta flava* Em. Lake Louise, Laggan, Alta., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 152.

Epeiridæ.

 * *Singa campestris* Em. Kenora, Ont.; Edmonton, Alta., (J. H. Emerton); Trans. Conn. Acad. Sci., Vol. 20, 153.
41. *Epeira carbonaria* Koch. Laggan, Alta., Aug. 12, 1914, (J. H. Emerton).
41. *Epeira marmorea* Clerck. Banff, Alta., Aug. 27, 1914, (Sanson).

Thomisidæ.

48. *Xysticus ferrugineus* Em. Banff, Alta., July, 1913, (Sanson).
48. *Xysticus triangulosus* Em. Banff, Alta., July, 1913, (Sanson).
49. *Coriarachne brunneipes* Banks. Banff, Alta., Aug., 1914, (Sanson).
51. *Thanatus coloradensis* Keys. Banff, Alta., June, 1912, (Sanson).
52. *Philodromus inquisitor* Thor. Banff, Alta., (Sanson).

Lycosidæ.

55. *Lycosa albohastata* Em. Banff. Alta., (Sanson): Mecatina, South Labrador, July, (C. W. Townsend).
55. *Lycosa beani* Em. Banff, Alta., Sept. 7, 1913, (Sanson).
56. *Lycosa fumosa* Em. Banff, Alta., Sept. 7, 1913, (Sanson).
57. *Lycosa quinaria* Em. Old Romaine, Southern Labrador, July, (C. W. Townsend).
59. *Pardosa gracialis* Thor. Laggan, Alta., Aug. 1914, (J. H. Emerton).
* *Pardosa albiceps* Em. Spray River, near Banff, Alta., (Sanson); Trans. Conn. Acad. Sci., Vol. 20, 153. Type locality with description, given in error as "Spray River, B.C."
59. *Pardosa grœnlandica* Thor. Banff, Alta., June 25, 1912; Sept. 7, 1913, (Sanson); Old Romain and Natashkwan River, South Labrador, (C. W. Townsend).
59. *Pardosa glacialis* Thor. Blanc Sablon, South Labrador, July: Natashkwan River, South Labrador, July, (C. W. Townsend).
60. *Pardosa luteola* Em. Banff, Alta., Aug. 8, 1914, (Sanson); Old Romaine, South Labrador, July, (C. W. Townsend).
60. *Pardosa tachypoda* Thor. Banff, Alta., July 4, 1914, (Sanson).

Attidæ.

66. *Dendryphantes flavipedes* Peck. Banff, Alta., (Sanson).
* *Pellenes sansoni* Em. Spray River, near Banff, Alta., (Sanson); Trans. Conn. Acad. Sci., Vol. 20, p. 154.

INDEX

Forty-Seventh Annual Report

OF THE

Entomological Society

OF ONTARIO

1916

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PRINTED BY ORDER OF

THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by A. T. WILGRESS, Printer to the King's Most Excellent Majesty
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WILLIAM BRIGGS
Corner Queen and John Streets
Toronto

To His Honour, Sir John Strathearn Hendrie, a Lieutenant-Colonel in the Militia of Canada, etc., etc., etc.,

Lieutenant-Governor of the Province of Ontario.

May it Please Your Honour:

The undersigned begs to present for the consideration of your Honour, the Report of the Entomological Society for 1916.

Respectfully submitted,

William H. Hearst,

Minister of Agriculture.

Toronto, 1917.

CONTENTS

FORTY-SEVENTH ANNUAL REPORT

OF THE

Entomological Society of Ontario

1916

To the Honourable William H. Hearst, Minister of Agriculture:

SIR,—I have the honour to present herewith the Forty-seventh Annual Report of the Entomological Society of Ontario, containing the proceedings of the Fifty-third Annual meeting, which was held at Guelph on the 2nd and 3rd of November, 1916.

The meeting was well attended and the interest shown by those present in the papers and addresses presented was evident from the lengthy discussions by which they were followed. A full report of these papers and discussions is contained in the following pages, together with the reports of the various officers and branches of the Society.

The work of the Society continues to expand and has been much increased by the activities of the British Columbia and Nova Scotia Branches.

The Canadian Entomologist, the Society's monthly organ, continues to maintain a wide circulation and a high standard of scientific value. In the forty-eighth volume now completed the series of articles on Popular and Practical Entomology, begun in the preceding volume, has been continued regularly and has done much to widen its usefulness and interest to the general reader.

I have the honour to be, Sir,

Your obedient servant,

EDMUND M. WALKER,
Editor.

Biological Department,
University of Toronto.

Entomological Society of Ontario

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President—Mr. Albert F. Winn, Westmount, Que.

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Editor of "The Canadian Entomologist"—Prof. E. M. Walker, Toronto.

Delegate to the Royal Society of Canada—Mr. F. J. A. Morris, Peterborough, Ont.

FINANCIAL STATEMENT

For the Year Ending October, 31st, 1916.

Receipts.		*Expenditures.*	
Balance from 1914-15	$23 82	Cork and pins	$91 59
Dues	151 60	Printing	1,185 49
Subscriptions	428 73	Expense	70 20
Advertising	38 25	Salaries	250 00
Government grant	1,000 00	Library	6 53
Reports and back numbers	105 31	Annual meeting	59 15
Cork and pins	111 07	Annual report	170 00
Bank interest	11 91	Bank exchange	10 15
		Balance on hand	27 58
	$1,870 69		$1,870 69

To balance due printers	$66 96
By cash on hand	27 58
Net deficit	$39 38

Auditors: L. Caesar.
J. E. Howitt.

Respectfully submitted,
A. W. Baker,
Secretary-Treasurer.

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Rowland, H. F. ....Guelph.
Saxby, J. W. ....Toronto.
Shorey, W. P. ....Vineland Sta.
Sladen, F. W. L. ....Ottawa.
Smith, Arthur ....Toronto.
Snazelle, C. .... "
Snazelle, Chas. ....Thornloe.
Spencer, Capt. G. J. .....Guelph.
Spencer, J. B. ....Ottawa.
Swaine, J. M. .... "
Strickland, E. H. .... "
Thompson, W. R. ....London.
Tomlinson, A. H. ....Guelph.
Walker, Prof. E. M. .....Toronto.
Watson, Dr. A. H. R. ....Port Hope.
White, James. ....Snelgrove.
Wood, S. T. ....Toronto.
Wright, Capt. W. H. ....Guelph.
Zavitz, E. J. .... Toronto.

QUEBEC.

Barwick, E. C. ....Montreal.
Beaulne, J. J. ....Ottawa.
Brainerd, Dwight ....Montreal.
Burgess, Dr. T. J. W. ....Verdun.
Chapais, J. C. ....St. Denis.
Chagnon, G. ....Montreal.
Clayson, G. H. .... "
Corcoran, J. A. .... "
Davis, M. W. ....Westmount.
Dunlop, G. C. ....Montreal.
Du Porte, E. M. ....Macdonald College.
Germain, Bro. ....Three Rivers.
Gibb, L. ....Montreal.
Holmes, J. G. ....Westmount.
Huard, Rev. V. A. ....Quebec.
Leopold, Rev. Father ....La Trappe.
Letourneau, F. ....Oka.
Lochhead, Prof. W. ......Macdonald College.
Moore, G. A. ....Montreal.
Poirier, M. .... "
Southee, G. A. .... "
Baird, Thomas .... High River.
Winn, A. F. ....Westmount.

ALBERTA.

Antijutti, Miss E. ....Barons.
Bentley, Lettice ....Lethbridge.
Bowman, K. ....Edmonton.
Carr, F. S. .... "
Dod, F. H. Wolley ......Midnapore.
Imeson, Miss V. ....Barons.
Mackie, Donald ....Edmonton.
Moodie, Miss ....Ogden.
Phillips, E. ....Lacombe.
Scarborough, J. W. ......Barons.
Whitehouse, F. C. ....Red Deer.

NEW BRUNSWICK.

Tothill, J. D. ....Fredericton.

NOVA SCOTIA.

Abbott, Winona ....Forbes Point.
Allan, E. Chesley ....Yarmouth.
Baird, W. W. ....Nappan.
Blair, W. S. ....Kentville.
Brittain, Prof. W. H. ....Truro.
Cann, E. Mabel ....Yarmouth N.
Conrad, Ethel M. ....Halifax.
Craig, I. C. ....Amherst.
Creighton, G. ....Halifax.

De Wolfe, L. A. ....Truro.
Dickey, C. M. ....Kentville.
Distant, Mary S. ....Halifax.
Dustan, A. G. ....Bridgetown.
Gilliatt, F. C. ....Granville Centre.
Good, C. A. ....Truro.
Gooderham, C. B. .... "
Goodwin, Alberta ....Stewiacke.
Henrion, Miss C. ....Halifax.
Jennison, Mary ....Truro.
Lindsay, Harriet E. .... "
MacPherson, Dr. Hugh ..Antigonish.
McGregor, Anna ....South River Lake.
McKay, Dr. A. H. ....Halifax.
Mitchell, Lillie J. ...... "
Moses, Agnes ....Brooklyn.
Payne, H. G. ....Granville Ferry.
Payne, S. H. .... "
Perrin, Joseph ....Halifax.
Sanders, G. E. ....Bridgetown.
Scott, Prof. J. M. ....Truro.
Shaw, Prof. P. J. .... "
Shipton, J. W. ....Moschelle.
Sinclair, Nellie ....South River Lake.
Smith, M. Lois ....Truro.
Spittall, J. P. .... "
Trevoy, Nellie M. ....Brighton.
Wetmore, Ralph ....Yarmouth.
Whitehead, W. E. ....Kentville.
Whitman, C. F. U. ......Lawrencetown.
Williams, C. M. ....Nappan.
Young, Ermina ....Brighton.
Young, M. E. ....Middleton.

SASKATCHEWAN.

Androchowicz, E. ....Humboldt.
Bentley, Miss L. ....Mellville.
Hutchinson, H. ....Starblanket.
Neville, S. J. ....Cottonwood.
Ritchie, J. D. ....Vanguard.
Willing, Prof. T. N. .....Saskatoon.

MANITOBA.

Criddle, Norman ....Treesbank.
Hippesley, Mrs. W. W. ..Winnipegosis.
Hunter, Dr. A. J. ....Teulon.
Wallis, J. B. ....Winnipeg.

BRITISH COLUMBIA.

Abriel, T. ....Nakusp.
Anderson, E. M. ....Victoria.
Anderson, J. R. .... "
Baggs, A. E. ....Vancouver.
Bayley, H. .... "
Blackmore, C. H. ....Victoria.
Brinkman, M. .... "
Bryant, T. ....Ladysmith.
Bush, A. H. .... Vancouver.
Cockle, J. W. ....Kaslo.
Cunningham, C. ....Victoria.
Day, G. O. ....Vancouver Island.
Downes, N. ....Saanichton.
French, P. E. ....Salmon Arm.
Gavet, D. ....Vancouver.
Gemmel, M. ....Sechelt.
Getchell, F. H. ....Vancouver.
Hadwen, Dr. S. ....Agassiz.
Hamilton, J. A. ....Vancouver.
Hanham, A. W. ....Duncan's Station.
Harris, Miss M. .... Deroche.
Hoy, B. ....Vernon.
Hook, G. ....Cobble Hill.
Howitt, M. W. ....Prince Rupert.
Hugh, W. .... Victoria.
Lallemand, C. F. ....Lytton.
Leach, D. H. ....Salmon Arm.
Martin, A. ....Vancouver.
Matthews, C. W. .... "
Middleton, M. ....Nelson.
Parham, G. L. ....Invermere.
Raley, G. ....Chilliwack.
Robertson, W. H. ....Victoria.
Robson, A. C. U. .... "
Ruhman, M. ....Vernon.
Sherman, R. S. ....Vancouver.
Stevens, M. G. .... "
Taylor, L. E. ....Kelowna.
Thornber, C. L. ....Vancouver.
Thornber, H. ....Kamloops.
Treherne, R. C. ....Agassiz.
Venables, E. P. ....Vernon.
Ward, W. E. ....Vancouver.
Warren, Miss E. ....Barnston Island.
Wilkerson, G. E. ....Victoria.
Wilson, Tom ....Vancouver.
Winslow, R. M. ....Victoria.
White, E. W. ....Sardis.

HONORARY MEMBERS

Cockerell, Prof. T. D. A...Boulder, Col.
Comstock, Prof. J. H. ....Ithaca, N.Y.
Cresson, Ezra T. .... Philadelphia, Pa.
Felt, Dr. E. P. ....Albany, N.Y.
Howard, Dr. L. O. ......Washington, D.C.
Wickham, Prof. H. F. ...Iowa City, Ia.

LIFE MEMBERS

Bethune, Rev. C. J. S. ...
Professor of Entomology, Ontario Agricultural College, Guelph.
Evans, John D., C.E. ....Trenton.
Fyles, Rev. Dr. T. W. ....Ottawa.
Reed, E. Baynes .... "
Director of the Meteorological Station, Victoria, B.C.

The Entomological Society of Ontario

ANNUAL MEETING

The Fifty-third Annual Meeting of the Entomological Society of Ontario was held at the Ontario Agricultural College, Guelph, on Thursday and Friday, November 2nd and 3rd, 1916. The President of the Society, Mr. A. F. Winn, Westmount P.Q., occupied the chair. The following were present during the sessions: Dr. L. O. Howard, Chief of the Bureau of Entomology, Washington, D.C.; Prof. P. J. Parrott, Geneva, N.Y.; Prof. E. M. Walker, University of Toronto; Prof. W. Lochhead, Macdonald College, P.Q.; Prof. W. H. Brittain, Truro, N.S.; Dr. C. Gordon Hewitt, Messrs. A. Gibson and J. M. Swaine, Entomological Branch, Ottawa; Messrs. W. H. Harrington and F. W. L. Sladen, Ottawa; Rev. Father Leopold, La Trappe, P.Q.; Mr. F. J. A. Morris, Peterborough; Mr. J. Dunlop, Woodstock; Prof. J. Dearness, London; Mr. W. A. Ross, Vineland Station; Mr. W. E. Biggar, Hamilton; Mr. N. Criddle, Treesbank, Man.; Mr. A. B. Baird, Fredericton, N.B.; Professors C. A. Zavitz, J. E. Howitt, C. J. S. Bethune, L. Caesar, J. W. Crow, D. H. Jones, E. J. Zavitz and S. B. McCready, Dr. R. E. Stone, Capt. G. J. Spencer, Messrs. A. W. Baker, A. H. Tomlinson, G. H. Unwin, C. R. Klinck, G. F. Kingsmill, E. Hearle, A. W. Guild, R. M. Aiton, J. B. McCurry and W. Evans, Ontario Agricultural College.

On Thursday morning a meeting of the Council was held in the Entomological Laboratory, at which the report of the proceedings during the past year was drawn up and various matters relating to the Society's welfare were discussed. A recommendation was made that Mr. John D. Evans, of Trenton, a past President of the Society and a most useful adherent for many years, should be elected a life member. This was subsequently done at the general meeting. It was decided that the next annual meeting be held at Macdonald College, Que. The President proposed that information regarding the principal collections of insects in Canada, both public and private, should be procured and published in the *Canadian Entomologist* from time to time.

At 1.30 p.m., the Society met in the Entomological Lecture-room. The President, Dr. Hewitt, took the chair and the proceedings commenced with the reading of the reports of the various officers of the Society and directors of the various divisions on the insects of the year.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1915-1916.

The Fifty-second Annual Meeting of the Society was held at Ottawa on Thursday and Friday, November 4th and 5th, 1915; the President, Dr. C. Gordon Hewitt, occupied the chair. The attendance was very gratifying, members being present from nearly every Province of the Dominion, and also several eminent entomologists from the United States, and Mr. C. P. Lounsbury, Chief of the Division of Entomology, Pretoria, South Africa. A large number of papers of interest and importance were read and discussed. The usual public lecture was

given by Prof. H. T. Fernald, of Amherst, Mass., on "Life Zones in Entomology and Their Relation to Crops," on the Thursday evening, and on Friday evening the members were the guests at a smoker given by the Ottawa Field Naturalists' Club. The morning and afternoon sessions were occupied by the reading of papers and the presentation of reports from the officers of the Society and the Directors of several of the Divisions.

The following is a list of the papers: "Insects of the Season in Ontario," and "The Imported Willow or Poplar Borer or Curculio," by Prof. L. Caesar; "Side Injury and Codling Moth," by Dr. E. P. Felt; "The Home of Gortyna stramentosa," by Mr. A. F. Winn; "Insects of Ste. Anne's, Que., Season of 1915," and "The Occurrence of Tychius picirostris on Clover at Ste. Anne's, Que.," by Mr. E. M. Du Porte; "Observations on Parasitic and Predaceous Hymenoptera," by Dr. T. W. Fyles; "The Leaf-weevil in New York," by Messrs. P. J. Parrott and H. Glasgow; "The Green Apple-bug in Nova Scotia," by Mr. W. H. Brittain; "A Capsid Attacking Apples," by Mr. H. G. Crawford; "The Founding of the Science of Cecidology," by Dr. A. Cosens; "The Army Cutworm in Southern Alberta," by Mr. H. E. Strickland; "Life Zones in Entomology and Their Relation to Crops," by Prof. H. T. Fernald; "Some Notes Regarding Nose and Other Bot-flies," by Prof. W. Lochhead; "The Seasonal Prevalence of Hypoderma bovis in 1915," by Dr. S. Hadwen; "Progress of Entomology in Canada during 1915," by Dr. C. Gordon Hewitt; "The Life-history of Chermes cooleyi in Stanley Park, B.C.," by Mr. R. N. Chrystal; "The Cabbage-maggot—Autumn Development in B.C.," "The Cabbage-maggot in B.C.—Natural Control," and "Preliminary List of Canadian Parasitic Insects," by Mr. R. C. Treherne; "The Brown-tail Moth and Gypsy-moth situation in Relation to Canada," by Mr. J. D. Tothill; "Control of the Brown-tail Moth in Nova Scotia," by Mr. G. E. Sanders; "The Work Carried on in the United States Against the Gipsy and Brown-tail Moth," by Mr. A. F. Burgess; "Leaf-rollers Attacking Apples," by Prof. L. Caesar; "Locust Control Work with Poisoned Baits in Eastern Canada in 1915," and "The Entomological Record," by Mr. A. Gibson.

The Canadian Entomologist, the official organ of the Society, has been regularly issued each month; the forty-seventh annual volume was completed in December, 1915. It contained 417 pages and was illustrated with seventeen plates and thirty smaller figures in the text. A series of monthly papers on "Popular and Economic Entomology" added much to the interesting character of the contents; 21 new genera and 101 new species and sub-species were described. The contributors to its pages numbered sixty-one, and included writers in Ontario, Quebec, Nova Scotia, Manitoba, Alberta, British Columbia, fourteen of the United States, Honolulu, Japan and Finland. It is gratifying to know that, while subscriptions from the enemy countries of Europe have been discontinued, the number of subscribers has considerably increased.

Owing to the fact that most of the members of the Society in Guelph were taking military drill, the regular meetings of the Society during 1915-16 were few in number, and were largely of a business character. During the year, however, the following papers were read:

"Methods of Rearing, Studying and Combating Cut-worms and Army-worms in Western Canada," by Mr. F. W. Walsh; "Parasitic Work in Nova Scotia," by Mr. A. B. Baird; "Syrphus Flies and Their Role in the Control of Aphids," by Mr. H. Curran.

During the year seventy-six new members have been added to the rolls of

the Society. Many members are absent on military service: where the dues of these members have not been paid they have been retained in membership without payment of dues wherever the Council knew they were in service.

It is with much regret that the Council has to record the loss of Captain R. V. Harvey, for many years the energetic Secretary of the British Columbia Branch, who was severely wounded in action in France and died in a German prison. We have also to deplore the loss of one of our esteemed honorary members, Mr. F. M. Webster, chief of the section of Cereal and Forage Insect Investigations in the Bureau of Entomology at Washington, D.C., who died at Columbus, Ohio, immediately after the meeting of the American Association for the Advancement of Science on the 2nd of January last. He was elected an honorary member of our Society in October, 1899, and always took an interest in our proceedings. His last visit to us was in August, 1913, when he attended our Jubilee meeting and read an interesting paper. An appreciative obituary notice by Dr. Hewitt was published in the March number of *The Canadian Entomologist*.

REPORT OF THE CURATOR.

During the past year no accessions have been made to the Society's collections. They have all been gone over several times and are kept entirely free from Museum pests. Donations of uncommon species of Lepidoptera and Coleoptera, and of almost anything in the other orders, would be very acceptable and gratefully acknowledged.

G. J. SPENCER, *Curator.*

REPORT OF THE LIBRARIAN.

During the year ending October 31st, 1916, forty-two bound volumes have been added to the Library, making the number on the register 2,262. A large number of unbound bulletins, reports, periodicals and pamphlets continue to be received from authors and publishers and in exchange for *The Canadian Entomologist*. Many of these are arranged in pamphlet-cases, and can be referred to without much difficulty. A certain amount of binding has been done recently, and, if funds permit, a considerable number more of important periodicals will be rendered available in this way for easy reference and a permanent place upon the shelves.

The excellent Library that we possess is being constantly made use of by the staff and students of the Biological Department of the Ontario Agricultural College, and to some extent by members of the Society at a distance.

Respectfully submitted,

CHARLES J. S. BETHUNE, *Librarian.*

REPORT OF THE MONTREAL BRANCH.

The 43rd annual meeting of the Montreal Branch was held at 794 St. Urbain St., Montreal, Que., on Saturday evening, May 13th, 1916.

The Secretary read the report of the Council as follows:

The Branch has held, during the season 1915-1916, eight monthly meetings, the average attendance being nearly seven.

We record with pleasure three new members added to our roll during the year.

During the year the following papers were read:

1. Annual Address of the President .... A. F. Winn.
2. Notes on the Natural History at the Toronto Fair .... Geo. A. Moore.
3. Collecting Hemiptera at Bondville, Que., August 1-13, 1915 .. Geo. A. Moore.
4. Lepidoptera taken by Geo. A. Moore at Bondville, Que...... A. F. Winn.
5. The Home of Gortyna Stramentosa, Guenée .... A. F. Winn.
6. Notes on Hemiptera taken at Bondville, Que. .... Geo. A. Moore.
7. The Reduviidae and Allied Families taken at Bondville, Que.... Geo. A. Moore.
8. A Few Remarks About the Genus Plagodis .... A. F. Winn.
9. Colias Alexandra, Edwards .... A. F. Winn.
10. Talk on the Entomology of British Columbia .... R. C. Treherne.
11. Talk on Insect Behaviour .... E. M. Du Porte.
12. Membracids taken at Bondville, 1915 .... Geo. A. Moore.
13. Variation .... A. F. Winn.
14. Talk on the Making of Microscope Sections of Insects' Eggs. Dr. J. A. Corcoran.
15. Talk on Making Slides of Genitalia .... G. Chagnon.

Our meetings were held at the residences of members except the February meeting which was held in the "Lyman Entomological Room," Redpath Museum, McGill University. This meeting was of particular interest. Fifteen were present, amongst whom were Prof. Lochhead with four others from Macdonald College and Mr. Treherne. Secretary of the British Columbia Branch. A pleasing event of this meeting was a presentation to our President, Mr. Winn, of an engraved silver plate from Lord Rothschild in recognition of his work in entomology. The presentation was made by Mr. Gibb who was in Canada on a visit.

One outing was held to St. Hilaire on May 24th.

The report of the Librarian showed our library in good order.

The report of the Treasurer showed a good balance in hand.

The following officers were elected for the ensuing year:

President .... A. F. WINN.
Vice-President .... G. CHAGNON.
Secretary-Treasurer .... GEO. A. MOORE.
Librarian .... G. CHAGNON.
Council .... G. A. SOUTHEE, E. C. BARWICK, H. M. SIMMS, DR. CORCORAN.

GEO. A. MOORE,
Sec.-Treas.

REPORT OF THE TORONTO BRANCH.

The Toronto Branch of the Entomological Society of Ontario begs to report as follows on the work of the Branch for the year 1915-1916.

The twentieth annual meeting was held in the Biological Building on Thursday, October 26th, 1916, the President, Dr. Walker, in the chair.

The minutes of the previous meeting having been read and approved the reports of the Council and the Treasurer were presented and adopted.

Eleven meetings, including the annual meeting and one field meeting, were held during the season, the average attendance at the regular meetings being about twelve, including visitors, of which a few were present at most of the meetings.

During the past year seven new members were elected. These are: Miss B. K. E. Mossop, Miss Marjorie Ford, Miss Norma Ford, Kenneth Kirkwood, T. B. Kurata, George Graham, and H. V. Andrews.

The financial statement showed a balance in hand of $3.52.

The following list comprises the papers and lectures of the season:

Oct. 14. "The Founding of the Science of Cecidology." A. Cosens.
Nov. 18. "Notes from Newfoundland." E. M. Walker.
Jan. 4. "The Spiders of Canada," illustrated by lantern slides. Prof. J. H. Emerton, Boston, Mass.
Jan. 27. "Canadian Longicorn Beetles," illustrated with specimens. E. M. Walker.
Mar. 2. "The White Wax Industry of Sey Chuan," illustrated by lantern slides. P. M. Bayne.
Mar. 30. "Bacterial Control of Insects." C. E. Petch, Ottawa.
Apr. 25. "Bombidae," illustrated with specimens. C. W. Nash.
May 30. "Mosquitoes and Their Relation to Human Disease," illustrated with lantern slides. E. M. Walker.
June 22. "Some Important Achievements in Entomology." A. Cosens.

On June 30 a field meeting was held at Lambton.

The election of officers for the ensuing year resulted as follows:

President ....Dr. E. M. Walker.
Vice-President ....Dr. W. A. Clemens.
Secretary-Treasurer ....Shelley Logier.
Librarian ....Miss B. K. E. Mossop.
Council ....Dr. A. Cosens, Mr. T. B. Kurata, Mr. C. W. Nash and Mr. J. Hannibal.

The Toronto Branch regrets to record the death of one of its oldest and most valued members, Mr. J. B. Williams, who died on the 28th of May, 1916.

Respectfully submitted,

Shelley Logier,

Secretary-Treasurer.

REPORT OF THE NOVA SCOTIA ENTOMOLOGICAL SOCIETY.

The second annual meeting of the Entomological Society of Nova Scotia was held at Truro, on August 4th, 1916, some 105 persons being in attendance. The proceedings took the form of a short business session in the morning, followed by the reading of papers at the afternoon and evening meetings. Following the afternoon session a short collecting trip was made, during which a number of interesting captures were made and discussed.

The following officers for the year were elected:

Hon. President ....Dr. A. H. McKay, Halifax.
President ....E. C. Allen, Truro.
Vice-President ....L. A. DeWolfe, Truro.
Secretary-Treasurer ....W. H. Brittain, Truro.
Assistant Secretary-Treasurer... G. E. Sanders, Annapolis.
Committee ....J. M. Scott, Truro; A. G. Dustan, Annapolis.

W. H. Brittain,
Secretary-Treasurer.

REPORT OF THE ENTOMOLOGICAL SOCIEY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA.

F. J. A. Morris, *Peterborough.*

I have the honour to present a report of the Entomological Society of Ontario for the year 1915-1916.

The Society continues to flourish; its growth in the short interval since our Jubilee Year has been remarkable, and to a close observer will reveal a most healthy condition—deepening as it broadens; this vertical growth (marked by a greater intensity of work) is even more vital than the lateral expansion of the Society over a wider field.

The branching tendency of the parent stem is amply evidenced both west and east; for in the still young B.C. branch there has been dichotomy into branchlets at Victoria and Vancouver, while in Nova Scotia an entirely new and vigorous branch has lately thrust forth. Both these extensions are due to members of the Society employed in the work of economic entomology: Mr. Treherne in the west and Dr. Brittain in the east.

There can be no question that the Society owes its present exuberance in very great measure to the comparatively recent institution of our Agricultural Colleges and the giant strides over the Dominion, in the last decade, of Economic Entomology. The scientific training in biology, acquired by a whole army of field officers and other Government employes in connection with Agriculture, enables these young and energetic students of nature to grapple with problems in insect anatomy and physiology, in life-histories, in systematic and descriptive work that would baffle, should they ever confront, the amateur. And these graduates are called to the most distant and diverse fields of labour.

All this is clearly reflected in the pages of our magazine: every month shows work of permanent value in economic entomology, and articles that may fairly claim the title of monographs in many special departments of the Science, articles coming from writers in all parts of the Dominion and beyond.

It is worthy of note how many contributors to our Ontario magazine are distinguished authorities of the U.S.A.—some of them men of world-wide reputation. Insects, of course, are too doggedly cosmopolitan to be daunted by the immigration officer, whether clearly undesirables or belonging only, like the rest of us, to the great class of those who have not yet been found out. Under these conditions our Science knows no artificial boundary and will not be so confined. But it has often been remarked by members of the Society, and at our annual meeting last November, where it found ample illustration, it drew a comment from the guest of honour, Dr. Fernald, of Amherst, Mass., how cordial are the relations of give-and-take in Entomology between the United States and Canada.

Obviously, in the borderland, steps taken by one country's Government to control insect pests, benefit the other; but it is not in economic work only that these friendly relations are found to subsist. Many of the finest articles contributed to the "Canadian Entomologist" by specialists over the line,-have reference to rare, entirely new, or hitherto unrecorded captures made within our borders by Canadian members of the Society, and sent for determination to recognized masters of the craft.

Among contributions of importance from native pens may be mentioned articles by the emeritus editor, Dr. Bethune; the editor, Dr. Walker; the Dominion

Entomologist and ex-President of the Society, Dr. Hewitt; the President of the current year, Mr. Winn, of Montreal; Messrs Caesar and Baker, of Guelph; Dr. Cosens, of Toronto; Messrs. Gibson, Swaine and Sladen, of Ottawa; Messrs. Wolley Dod and Strickland of Alberta; Messrs. Criddle and Wallis, of Manitoba; and Mr. Sanders, of Nova Scotia.

We have noticed also in the pages of the magazine since last report, reference to the insect fauna of Chile, Guatemala, British Guiana, the Philippines, Australia, India, Sweden and Finland.

Among *personalia* may be mentioned a delightful sketch of the late Prof. Croft, of Toronto University, from the pen of our esteemed Dr. Bethune, an appreciation of the great Jean Henri Fabre, and an obituary notice of our late honorary member Francis Marion Webster, both written by Dr. Gordon Hewitt.

The interest of the Society's periodical has greatly broadened under the capable hands of its editor, not only by the inclusion of two new sections, one of Popular Entomology, the other of Notes and Queries, but still more by systematic insertions from authoritative centres of activity, selected with wise judgment from diverse points of the United States and Canada.

The annual meeting held in Ottawa last November was one of the most successful in the whole history of the Society, representing practically all its interests over the whole wide area of its membership. The papers and articles there presented are now in the press and will shortly appear as the 46th Annual Report of the Society. They include a very large amount of research work of the greatest practical value and of a high order of scientific merit.

The titles and authors' names (see 46th Annual Report, Table of Contents) may be left to speak for themselves and for the full significance of that November meeting; with perhaps a single exception, which I crave leave to make more explicit; to wit, the supreme importance of work done on the spot by field laboratories, no fewer than nine of which have now been established in various parts of the Dominion, under the auspices of the Entomological Branch of the Dominion Department of Agriculture.

REPORTS ON INSECTS OF THE YEAR.

Division No. 1, Ottawa District—Arthur Gibson, Entomological Branch, Ottawa.

Attacking Field Crops.

Fortunately there were no serious outbreaks of field crop insects in the district of eastern Ontario which I have the honor to represent. The dull, rainy weather of spring and early summer undoubtedly interfered in the development of many species.

Locusts. Early in the season a few reports were received which indicated that young hoppers were appearing in numbers, but on investigation later we learned that the insects disappeared suddenly, owing to adverse weather conditions. We had arranged to conduct further experiments in the control of these insects with poisoned baits, but no fields sufficiently infested with locusts could be located in the Ottawa district.

Cutworms. Reports of damage by these caterpillars received early in June referred particularly to injury to cucumbers, beans, peas and other vegetables in

gardens. The Red-backed Cutworm, (*Euxoa ochrogaster* Gn.), was most in evidence.

Root Maggots. The Cabbage Maggot (*Phorbia brassicae* Bouche), and the Onion Maggot (*Hylemyia antiqua* Mg.) were again present in the Ottawa district, but the damage was not so extensive as in 1915. Some experiments which we conducted in the control of the latter insect by spraying with sodium arsenite indicated that such control is promising, and further work along this line will be done as opportunity occurs. Such control is discussed in Bulletin No. 12 of the Entomological Branch, issued in May, 1916.

The Potato Flea Beetle (*Epitrix cucumeris* Harr.). In the latter half of June this insect was present in noticeable numbers. Injury to the leaves of tomato was especially complained of.

The Corn Ear Worm (*Heliothis obsoleta* Fab.). A few complaints of injury to the ears of sweet corn were received in early September. On September 5th larvae in the last stage were found. The work of the caterpillars is seldom noticed until the injury has taken place. Fortunately this insect is not an important one in the Ottawa district.

The Banded Ips (*Ips fasciatus* Oliv.). On September 22, I found this beetle present in a few ears of corn in our experimental plots at the Central Experimental Farm. Several kernels in one ear had been destroyed. This injury is an unusual one, and so far as I know has not previously been reported in Canada. Similar injury has been recorded in the United States.

The Salt Marsh Caterpillar (*Diacrisia acraea* Dru.). This woolly bear was found in small numbers (August 11th) feeding on leaves of cabbages at Rivermeade, close to Ottawa. Although this caterpillar has a wide range of food plants the injury it causes is local. It can hardly be classed as a pest of importance. Handpicking will usually be sufficient as a control measure.

The Parsnip Webworm (*Depressaria heracleana* DeG.). At the Central Experimental Farm, the Dominion Horticulturist reported, on July 10th, an outbreak of the caterpillars of this insect in a patch of parsnip which he was growing for seed purposes. The larvae were numerous, on one day 170 were removed by hand from the plants.

The Zebra Caterpillar (*Ceramica picta* Harr.). An interesting outbreak of this well-known caterpillar occurred in eastern Canada during the autumn of 1916. In some sections the larvæ were present in thousands, stripping the tops of turnips, and also injuring other plants, chiefly mangels and cabbages. One outbreak which occurred near Ottawa effected particular damage to rhubarb.

The Ash-Gray Blister Beetle (*Macrobasis unicolor* Kby.). Reports of injury by this blister beetle to potatoes were received in early July. In one field which I visited on July 13th many of the plants had been entirely defoliated. Numbers of the beetles were present on the vines. Unfortunately, they have the habit of appearing suddenly and oftentimes eating the entire foliage of plants upon which they alight in a day or two. One grower protected his potato crop by dusting with arsenate of lead.

Attacking Fruit and Forest Trees.

No special outbreaks of insects attacking fruit or forest trees came to my attention during the season. The Pear-leaf Blister Mite (*Eriophyes pyri* Pag.) was found freely on the foliage of apple on July 11th. The Black Walnut Caterpillar,

(*Datana integerrima* G. & R.) was more than usually abundant, being found on walnut and hickory. Other common pests such as the Oyster Shell Scale, (*Lepidosaphes ulmi* L.), the Imported Currant Worm, (*Pteronus ribesii* Scop.), the Codling Moth, (*Carpocapsa pomonella* L.), etc., were more or less destructive in the district.

Garden and Greenhouse Insects.

Cutworms were frequently complained of as injuring plants in gardens. Sweet peas were freely attacked in one garden in the first half of June. At Meach Lake, Que. (near Ottawa) flowering plants were being injured at the end of June. The Red-backed Cutworm was the most commonly-occurring species.

The Tarnished Plant Bug (*Lygus pratensis* Linn.), was present in conspicuous numbers. Some growers of dahlias and zinnias claimed that large numbers of the buds had been destroyed by the insect. In one garden in Ottawa the bugs were very numerous in the middle of July, one lady reporting that almost all the zinnia plants in her garden had been destroyed. Unfortunately, there is no satisfactory remedy known for the control of this insect. Some growers claim to have had partial protection by dusting powdered tobacco over the buds or other portions of the plants which are attacked.

The Yellow Woolly Bear (*Diacrisia virginica* Fab.). Noticeable injury was caused by this caterpillar in gardens, particularly to the foliage of hydrangea. In the middle of July when some leaves were examined the larvæ were about half an inch in length. The leaves were conspicuously skeletonized in places.

Household Insects.

Ants. Some interesting experiments in the control of ants in houses were conducted during the past season. Near Chelsea, Que., about nine miles from Ottawa, perfect results in ridding summer cottages of ants were obtained by dusting sodium fluoride where the insects were numerous. This new remedy was also used in Ottawa and other places, and reports of success in all cases were received. In our own experiments the species of ants concerned were the common carpenter ant (*Camponotus pennsylvanicus* DeG), and the shed builder ant (*Cremastogaster lineolata* Say). An account of these experiments was published in the November 1916, issue of the "Canadian Entomologist."

Roaches (*Blattella germanica* Linn.). Sodium fluoride was also used with success in Ottawa in ridding a house of these objectionable insects. The powder was simply dusted in the places which were frequented by the roaches and almost immediately they began to disappear. Within a week no individuals were to be seen, where previous to the use of the powder the insects were present in numbers.

Carpet Beetles. The two carpet beetles, namely, the true Carpet Beetle, or Buffalo Moth (*Anthrenus scrophulariae* L.), and the Black Carpet Beetle (*Attagenus piceus* Oliv.), were reported as being present in destructive numbers in houses in Ottawa. No exceptional injury however was noted.

A few complaints were also received of the presence in houses of the Indian Meal Moth (*Plodia interpunctella* Hbn.) and the Confused Flour Beetle (*Tribolium confusum* Duv.). The former was found attacking breakfast cereals and the latter infested flour.

Division No. 3, Toronto District—A. Cosens.

In spite of the extremely hot, dry weather of July, August and September, nothing particularly striking was noted to indicate that the insect life was affected by the unusual character of the season. Some injurious insects were indeed rather more plentiful than usual, but others were not so common.

The Zebra Caterpillars, *Mamestra picta*, were exceedingly abundant on several species of plants. Even at the date of writing, the end of October, specimens of these yellow-striped larvæ are occasionally seen, crawling over the still green foliage of such plants as the clovers and asparagus. North of the city considerable damage was done to crops of turnips by this pest.

While the aphides were not so troublesome this season on the cultivated honeysuckles, another insect was found to be seriously injuring them. On some shrubs nearly every leaf was puckered and deformed by the mining of the larvae of

Galls produced by *Pontania petiolaridis* Rohwer on the leaves of *Salix petiolaris* Sm.

Phyllonorycter (*Lithocolletis*) *fragilella* Frey and Boll. The work of the insect is very characteristic and easily recognized, since the under sides of the infested leaves are covered with blister-like patches owing to the lower epidermis having been left intact, when the underlying mesophyll was eaten out. The larvae are from 5-6 mm. in length, and light-yellow in colour. They enter the ground after the fall of the leaves and emerge as moth early in the Spring. Gathering and destroying the leaves before the larvæ leave them, is, at this time of the year, the most apparent method of bringing the pest under control.

An almost spherical, sawfly gall is produced on the leaves of *Salix petiolaris* Sm., a native willow that is not uncommon in low ground near the city. The deformity closely resembles the conspicuous apple-like gall of *Pontania pomum* Walsh, but differs from this species in some details of structure. The host plants of the two galls differ as *Pontania pomum* is restricted almost, if not entirely, to

Salix cordata Muhl. In their attachment to the leaves of their hosts they also vary as the species on *Salix petiolaris* is almost equally divided by the blade, while *Pontania pomum* projects, only very slightly, from the upper side of the leaf. Further, the former species is hollow from the earliest stages, but the latter only becomes so when eaten out by the larvæ. A number of the galls from *Salix petiolaris* Sm. were collected in 1915, just before the fall of the leaves, and were kept, out-of-doors, in jars containing earth, during the winter. The adults began to emerge April 15th, and were sent to Mr. S. A. Rohwer, Washington, D.C., who has kindly replied as follows: "I have made a preliminary examination of the species and find that it may easily be distinguished from *Pontania pomum* and that it comes near to *P. pisum*. I think the species is undoubtedly new."

An interesting observation was made concerning this new species of sawfly, namely that the aperture of exit is prepared a considerable length of time before the larvæ leave the galls. Just what conditions finally prompt their departure and why their means of escape have to be ready, are points not yet cleared up.

Since all sawfly galls are well advanced in development before the larvæ are hatched, it is safe to conclude that the chief stimulus to abnormal growth must emanate from the ovipositor of the insect. The sawflies, when depositing eggs, clasp the opening buds with their legs and insert their sawlike ovipositors into the young leaves from the under side. Into each of the incisions, thus made, an egg is injected. The larvæ, as soon as hatched, commence to feed upon the substance in the interior of the gall, but leave the rind uninjured.

Since the pear-slug, *Eriocampa cerasi* Peck makes a similar incision in the leaf, without causing an abnormal production of tissue, it is highly probable that in the case of the sawfly gall-producers, the stimulus is not due to the mechanical effect of the cutting, but to a chemical action arising from the introduction of some substance by the ovipositor of the insect.

A specimen of the Compton Tortoise, *Vanessa j-album,* seen April 7th, marked the opening of the entomological season, and throughout the summer butterflies in general, were plentiful. In this connection the unusual abundance of the Monarch, *Anosia plexippus* L. should be noted. Since 1906, specimens of this species, have not been so numerous in this locality. During August, abundant evidence was furnished at different places of their congregating habits. On the island the poplars and willows were favorite resting sites for large flocks. The instinctive tendency to migrate southward in the autumn must have been the stimulus that impelled them to seek this outlying station. At different times straggling lines of these insects were noted moving westward along the lake shore.

Pontania petiolaridis New Species, Rohwer.

Belongs to Group 3 of Marlatt, and is closely allied to *salicis-pisum* Walsh, but may be distinguished from that species by the dark brown stigma, and by having the third antennal joint shorter than the fourth, and the third cubital cell much longer than high.

Toronto, Ontario. Described from a number of females and males reared by A. Cosens from galls on *Salix petiolaris.*

Type.—Cat. No. 20697, U.S.N.M.

A more extended description of this species will be published in connection with other species of this genus.

Division No. 5, Port Hope District— Francis J. A. Morris, Peterborough.

Your Director has been specializing almost entirely in *Cerambycidae* this season, and few observations in other families and orders have been made. The Report for the year will present, in brief pageantry, the procession of summer months from Spring to Autumn.

Early in April before the snow had entirely gone two or three specimens of *Disonycha triangularis* were noticed in the muddy ruts of a side road west of Peterborough; nearly a fortnight later two more specimens of the same beetle were captured in a similar situation north of Port Hope. During two very hot bright days in Easter week, large numbers of a beetle about the size of the common "June bug" were observed flying rapidly along just over the grass, and occasionally soaring up about the boulevards in Toronto; no capture was made, but the habit of flight makes probable their identification as *Euphoria inda*. This beetle we have never seen captured in the district of Port Hope or Peterborough; it is probably abundant west of Toronto, and has been taken about Orillia. Whether it breeds in S.W. Ontario or not, I do not know: at any rate it would seem to have spread by flight to a great distance from its original breeding ground. Its absence from the central district immediately north of Lake Ontario may be due to its low habit of flight; this would render a wide stretch of water a formidable barrier.

During the last week of April, and the first week of May, three specimens of *Hylotrupes ligneus* were taken in and about the City of Peterborough. From the first week of May for more than three weeks, specimens of *Pachyta monticola* were abundant; on Victoria Day upwards of 30 were captured in various blossoms, such as Crinkle-root (*Dentaria diphylla*), white Trillium (*Trillium grandiflorum*), large-flowered Cranesbill (*Geranium maculatum*), and—its favorite host—Early Elder (*Sambucus racemosa*). On the same shrub in the third and fourth weeks of May, several specimens of *Syneta ferruginea* were observed, and about the foliage of wild raspberries in the first two weeks of June this beetle was very abundant. *Lina interrupta* was taken feeding (as usual in this neighbourhood) on alder, and its next of kin, *Lina scripta* was found abundant on willows—especially low bushes bordering wet meadows and swamps. Observations made in 1914 and 1915 in regard to forms of the genus Chrysomela and their various food plants were renewed; one or two specimens of a more robust *Chrysomela scalaris* than that noticed on alder were captured; these had a more normal sculpture of the elytra and would seem to have bred out on basswood foliage.

On June 4th, while collecting about the margin of a wood some miles south-east of Peterborough, we noticed among some *Cyrtophorus verrucosus*, feeding on blossom of choke-cherry, a beetle very similar, but smaller and less prominent on the thoracic disc and elytral bases. Close examination of the insect showed it to be identical with a unique specimen captured in Port Hope on spiked maple in the year 1907. This insect had been returned from Montreal in 1909, labelled as the male of *Microclytus gazellula* Hald.; it being assumed for purposes of such determination that the length of the antennal joints 2, 3 and 4 *inter se* in that genus (as described by LeConte and Horn) was true only of the female, while the male had them proportioned as in *Cyrtophorus*. Twelve specimens of the beetle were captured on this day (June 4th, 1916) all on choke-cherry and among them a pair in conjunction; they all proved to have the proportion of joints 2, 3 and 4 constant, and as in *Cyrtophorus*. Between June 12th and June 18th, three more specimens were taken on the blossom of spiked maple. With the unique specimen of 1907, there was therefore a series of sixteen for purposes of comparison.

In all sixteen the second joint of the antennae was distinctly less than half the length of the fourth, somewhere between a quarter and a third the length. In the genuine *Microclytus gazellula*, the second joint is distinctly more than half the length of the fourth, somewhere between two-thirds and three-quarters the length. After the specimens had been thoroughly relaxed the antennae were drawn out taut over the back; in eight specimens the antennae proved as long as the insect, and in eight they were about three-quarters the length. One may fairly assume such a difference to be a sex distinction; probably the same difference will be found to distinguish the two sexes of *Microclytus gazellula* Hald., but it is most improbable that any difference in the proportionate length of joint 2 to joint 4 of the antennae should be found separating the sexes. Other differences are noticeable between this guest of the choke-cherry and *M. gazellula*, but whether the insect should be placed under the genus *Cyrtophorus* or under *Microclytus* I am not in a position to decide.

On June 13th seven specimens of *Callidium ianthinum* were captured on the bark of white cedar—newly cut fence rails. In the third week of June many Longicorns were captured on dogwood blossom: these included *Molorchus bimaculatus, Callimoxys sanguinicollis, Clytanthus ruricola, Cyrtophorus verrucosus, Encyclops caeruleus, Gaurotes cyanipennis, Leptura capitata, L. exigua, L. vittata, L. pubera, L. ruficollis* (with var. *sphaericollis*), *L. vibex, L. mutabillis;* these were all abundant: a single specimen of *L. sanguinea* was also captured, and a species not yet identified. In the same week along the C.P.R. east of the City of Peterborough, several colonies of *Lema trilineata* were observed on patches of ground cherry (Physalis), and on wild convolvulus 3 species of tortoise-beetle, *Coptocycla aurichalcea, C. guttata,* and *Chelymorpha argus.* Feeding on pollen the female of *Hoplia trifasciata* was frequently seen at this time, but only a single male; a collector in Port Hope who noticed this beetle earlier in the season, found the male predominant; this appears to be the rule of that species; the male appears first in great numbers about hawthorn and other blossoms; a week or two later, the males become rare and the females then become abundant. Owing to the unusually wet and cold weather in May and June many beetles seem to have been retarded. The first newly emerged Elder-borer this season was taken on June 22nd, nine days later than last year's record. In the third and fourth weeks of June many interesting species of *Elater* and *Buprestid* were taken, especially the genus *Corymbites.* On June 25th, north of Port Hope, a single specimen of *Lina tremulae,* a European leaf-eater, was captured on a poplar; it is known to occur in Massachusetts and Michigan. On the same day a small Longicorn hitherto new to your Director was observed on the leaf of a wild grapevine; a careful search resulted in the capture of a second specimen on grapevine about a mile further east in the district north of Port Hope; a third specimen on grapevine was taken in Trenton on June 27th; but persistent search of grapevines for more than a week failed to secure any more; the beetle was *Hyperplatys aspersa.*

While staying for a few days in Trenton at the end of June, your Director made some interesting captures. At Weller's Bay on June 28th, *Leptura lineola* was taken in abundance on dogwood blossom in low-lying wet hardwood bushes. At Glen Ross on the Trent, June 29th, was captured a small black *Oberea,* said to be the variety of *bimaculata* known as *basalis Lec.* It was taken on a wooded hillside among the undergrowth. Six specimens of the same creature were captured in flight, a few years ago, in an almost identical situation north of Port Hope; among the flora characteristic of such upland slopes are hazel bushes, wild rose,

bergamot, Painted Cup (*Castileia*) and Orange Lily. The insect is about eight millimetres in length, slightly over a millimetre wide across the thorax, entirely black, except for a patch of dusky orange on the disk of the thorax which serves to throw into relief, but still indistinctly, a pair of black spots at the centre. In the same district several leaf-eating beetles were observed in great abundance; on oak bushes *Attelabus analis*—over a score being counted on a single twig; on two or three species of undergrowth a large black *Pachybrachys;* and on Fragrant Sumach (*Rhus canadensis*) the larvæ and beetles of *Blepharida rhois*. Last year we ventured to claim for this larva absolute immunity, due to its disgusting coat of liquid excrement. To our astonishment we observed this day a large yellow plant-bug regaling himself on these unsavory morsels with all the relish of a sand boy picking out periwinkles with a pin.

On July 1st, during a tramp about the Big Swamp, Murray Township, north of Wooller, three or four specimens of *Leptura chrysocoma* were found feeding in the blossoms of that beautiful flower, the Swamp Valerian (*V. silvatica*). They were right out among the tamaracs almost in the heart of the swamp. Besides tamarac, a very few white pine and several spruce trees stood in this corner of the swamp. On July 2nd, at the same spot, *Leptura chrysocoma* was found feeding round the edge of the swamp, rare on fleabane, occasional on valerian, and abundant on yarrow heads; over 30 specimens were captured.

On July 5th a trip to some woods east of the Otonabee River, just north of Hiawatha, yielded good results. On some dying balsam a pair of *Acanthocinus obsoletus* and a pair of *Xylotrechus undulatus* were taken. On some fallen beech three species of *Agrilus* were seen, including *bilineatus* and *obsoletoguttatus:* also seven specimens of *Neoclytus erythrocephalus*, two of *Xylotrechus colonus*, two of *Urographis fasciatus*, and a single specimen of *Hoplosia nubila*. Of this last, four specimens have been taken about Peterborough since 1914, three on basswood and one on beech, confirming the hearsay statement of Blatchley in regard to the hosts of this beetle. Some fallen beech were examined in another quarter on July 14th, and a large number of *Xylotrechus colonus* and *Urographis fasciatus* were taken on the under side of the trunks. On July 10th and 13th, a newly felled grove of white pine was visited. Trunks, limbs, branches, twigs and foliage were all carefully examined, as well as the surrounding shrubs and herbage. Two species of *Monohammus* were found abundant, *confusor* and *scutellatus*, while a third, *titillator* was taken occasionally. These were mostly on the trunks; about limbs and branches, especially where broken and piled up— decay being further advanced here—were found several specimens of *Acanthocinas obsoletus* and *Leptostylus sex-guttatus;* besides these, eight or nine specimens of *Neoclytus muricatulus* were captured, running rapidly over the trunks and limbs in the hot sunshine. Till 1916 we had never seen this insect except on white pine, but two specimens were captured this July on white spruce, one on July 14th near Peterborough, and the other at the end of July in the Algonquin Park. Close by these pines, both fallen and standing, three *Acmaeops* were taken, two *Acmaeops pratensis* (on yarrow heads) and a single *Acmaeops proteus*. During the same trip a very minute specimen of *Pogonochaerus mixtus* was noticed on the bark of a pine log. Three or four only of these beetles have been taken on white pine during ten years of collecting, and it has never appeared common till this season. During the second week of July two hosts were discovered for the little Lamiinid *Hyperplatys aspersa*. These were the American aspen (*Populus tremuloides*) and the staghorn sumach (*Rhus typhina*); as several other borers were found in the same company, the two accounts are kept separate.

It was on July 6th that we first noticed *Hyperplatys aspersa* on the top of a woodpile. This pile consisted entirely of *Populus tremuloides*, cut into short-length cylindrical billets, the bark still on; the billets ranged from two or three to six or seven inches in diameter. During ten days, six visits were made to the woodpile; on each of the last three visits every billet in the pile was lifted and turned over for inspection, with the following result:

Hyperplatys aspersa, 117. (These insects were not collected after the fourth visit, though several were seen).

Liopus variegatus 13.
Liopus cinereus 6.
Acanthoderes sp? 2.
Pogonochaerus mixtus 2 (var. *salicola*, Casey.)
Parandra brunnea 1.
Saperda calcarata 1.

Also, several species of Endomychid, Clerid, Elaterid, Buprestid, Tenebrionid, and Rhynchophorid beetles.

During the same period Dr. Watson, of Port Hope, was having a similar experience about dying branches of sumach; his captures included *Goes oculata*, *Leptostylus macula*, *Liopus cinereus*, *Leptura signatus* and *Hyperplatys aspersa*.

The weeks from July 18th to the end of August, were spent in the Algonquin Park. About Cache Lake, on fallen balsam and spruce (besides white pine), *Monohammus confusor* and *M. scutellatus* were both observed; on spruce were captured single specimens of *Tetropium cinnamopterum*, *Neoclytus muricatulus* and the Melandryid, *Phloeotria quadrimaculata* (*Dircaea liturata*); on balsam, a single specimen of *Xylotrechus undulatus*. Apparently breeding about the branches of a small felled white pine over 100 specimens of *Pogonochaerus mixtus* were captured in five weeks. Several specimens of *Leptostylus 6-guttatus* were also taken on white pine. Half a dozen specimens of *Leptura canadensis* (all female) were taken about the woods, and as many (all male) feeding on spiræa blossom; no female was seen on blossoms. On spiræa were also taken both sexes of *L. subhamata*, *L. proxima*, *L. vagans* and some other common species; also two specimens of a very dark form of *L. plebeia*: this beetle had never been taken before 1916; but on July 6th we had been fortunate enough to observe a specimen settle on the trunk of a large white pine, just low enough not to afford one more tantalizing example of how the human enthusiast's reach exceeds his grasp.

Not many observations of economic interest were made during the season. Depredations of the willow-boring weevil were in further evidence about Port Hope where some specimens were noticed as early as the first week of June; in that neighbourhood it was found also on *Populus tremuloides*, and near Oshawa on Balm of Gilead; a patch of willows near Peterborough was noticed in September badly damaged by this insect. The wet May and June caused aphids to be quite a severe scourge to foliage, especially elm, poplar and maple. Grasshoppers in the later summer were terribly destructive, though less so in the Port Hope district (Mr. Duncan tells me) than elsewhere. Apple and other fruit trees whose branches were a riot of blossom in May and June managed to set very little fruit, the disastrous rains of the early summer having prevented insect fertilization.

Division No. 6, Essex District—J. W. Noble, Department of Agriculture, Essex.

Attacking Field Crops.

Wire Worms and White Grubs. During the wet spring of 1916 these pests did considerable harm to corn and other cereals; sugar beets were also destroyed and some damage was done in the onion fields. June beetles and click beetles seemed quite plentiful during the summer months and the writer obtained several of the former by the use of a lantern and pan of water covered with kerosene.

Attacking Fruit Trees

Codling Moth (*Carpocapsa pomonella*). Owing to the continued rainfall during the month of June the codling moth was very prevalent this spring. Very few side entrances have been found which would suggest that most injury was caused by first brood. In neglected orchards it seems that there is over ninety per cent. of the fruit affected.

Plum Curculio (*Conotrachelus nenuphar*). The injury of this beetle was very prevalent on plums especially during the past season; although not so plentiful upon the apples.

San José Scale (*Aspidiotus perniciosus*). Practically all uncared for orchards have been ideal breeding grounds for this pest this season and a large quantity of affected fruit is offered upon the markets. The pest is practically absent in well kept orchards.

Tent Caterpillars (*Malacosoma americana* and *M. disstria*). These pests seemed more prevalent than usual this year; the unsightly webs of both species were found in several orchards and woods. *M. americana* is the more common although neither can as yet be considered of great economic importance.

Aphids. These insects have done considerable harm in deforming the fruit in neglected apple orchards. On some of the smaller crops they did great damage and will be discussed later.

Cherry Fruit Fly (*Rhagoletis cingulata*). This was the most important pest of the sour cherry this year. Very few sweet cherries bore fruit this season but in former years this fly injured both types.

Lesser Peach Tree Borer (*Aegeria pictipes*). Some orchards have been ruined by this pest.

Insects Affecting Small Fruits and Vegetables.

Strawberry Sawfly (*Empria ignota*). On a number of patches during the past season the writer has observed injury from this species, the chief injury being that the fruit failed to ripen. Spraying with hellebore was successfully carried out in two fields.

Melon Aphids (*Aphis gossypii*). Fifteen thousand dollars is a conservative estimate of the damage borne by the melon growers during the past summer and a great loss to the pickle growers was also sustained. Twenty-five per cent. of the crops of inside cucumbers was lost by the lice. Successful spraying outside with tobacco decoction was demonstrated by this Department and good results were shown by inside fumigation with nicofume and black leaf 40.

Cabbage Root Maggot (*Pegomyia brassicæ*). Probably for the first time in this district this insect has caused a great deal of damage this season. Some crops of early cabbage were almost a failure.

ONION ROOT MAGGOT (*Pegomyia ceparum*). This is another arrival to report this season. In Mr. Caesar's report of last year I note he states that he could scarcely find a root maggot in this district. Unfortunately this is not the case in 1916. Great damage was wrought during the past season to the onion growers.

ONION THRIPS (*Thrips tabaci*). The writer has seen thousands of these insects in small areas during the past season. The characteristic white lines on the leaf indicated that they were doing considerable damage. We have tried almost all recommended remedies with indifferent success. They especially thrive in tobacco decoction. The writer has taken an onion covered with thrips, immersed it in the strong solution of tobacco for five minutes, then laid it in the sun and in a few minutes the insects seemed invigorated by the experiment.

TOBACCO WORM (*Phlegethontius quinquemaculatus*). As in former years this insect has cost the tobacco growers thousands of dollars in injury and labor to pick the worms. Successful work is being done by some growers in having the worms picked by ducks. The method of poisoning by attracting the moth to baits has been found satisfactory. This season one grower has killed more than a half bushel from three poisoned Jamestown plants (*Datura stramonium*).

GREENHOUSE INSECTS.

The chief greenhouse pests during the past season have been aphids, white fly and cucumber beetle. Successful fumigation for the former two has been carried on with nicofume, black leaf 40 and hydrocyanic acid gas, but a great deal of harm has been done by the beetle and methods of control are rather difficult. Hand picking has been practiced with the greatest success, but is rather laborious.

DISTRICT NO. 7; NIAGARA DISTRICT—WILLIAM A. ROSS.

ORCHARD INSECTS.

Comparatively few complaints were made this past season about the depredations of apple insects. This was largely due, I think, not to the scarcity of noxious insects but to the fact that evils such as the codling worm and the plum curculio were overshadowed by a greater evil—apple scab.

CODLING MOTH (*Carpocapsa pomonella*). Side injury by this species was more noticeable on apples this season than it was last year.

PLUM CURCULIO (*Conotrachelus nenuphar*). This insect was less injurious in the Vineland district than it has been for some time past.

THE GREEN APPLE APHIS (*Aphis pomi*). Early in the summer conditions were very favorable for the rapid development of plant lice. The weather was warm and there was a superabundance of food—succulent growth produced by the heavy spring rains. The apple aphis took full advantage of these conditions and it multiplied and spread at an alarming rate. During July the infestation was so severe that in certain orchards which I had under observation all the young shoots and watersprouts were covered with masses of green lice. The outbreak reached its height about the end of July and then, thanks to the effects of the drought, it commenced to decline very rapidly until by the last of August very few aphides were present on the trees.

SAN JOSÉ SCALE (*Aspidiotus perniciosus*). Apart from noticing an unusual quantity of scale-infested apples in certain Vineland orchards, I made no observations on this pest.

THE PEAR PSYLLA (*Psylla pyricola*). The cold, wet weather of spring was so fatal to the eggs and newly hatched nymphs of this species that our spraying tests in a Vineland orchard were completely nullified. The check pear trees proved to be as clean as the sprayed trees.

THE IMPORTED SPIDER MITE (*Tetranychus pilosus*). This acarid was again common on plums and apples. Our experiments with the mite prove that lime sulphur wash (summer strength) will readily control it.

BENEFICIAL ORCHARD INSECTS.

One of the most important enemies of the green and rosy aphides of the apple in the Niagara district is a small reddish cecidomyiid maggot. I have observed this creature at work during the past three seasons but did not have it identified until this year. The species is *Aphidoletes meridionalis*, Felt.

The feeding habits of this cecidomyiid are interesting. In attacking its victim the maggot, as a general rule, attaches its mouth parts to a leg joint and then proceeds to gorge itself on the body juices. The favorite point of attack is the articulation of the femur and tibia. (In one instance a maggot was observed with its mouth parts attached to the base of an antenna.)

The ladybirds *Hippodamia convergens* and *Coccinella novemnotata* were exceptionally common. During the summer both species were found feeding freely on the green apple aphis.

PESTS OF SMALL FRUITS.

THE BLACKBERRY LEAF MINER (*Metallus rubri*). A large blackberry plantation near Vineland was seriously infested by this sawfly.

So far as I am aware no satisfactory method of combating the miner has yet been discovered.

THE RASPBERRY SAWFLY (*Monophadnus rubi*). This species was again very injurious.

THE IMPORTED CURRANT BORER (*Aegeria tipuliformis*). Complaints about the work of the borer were received from Burlington.

SHADE TREE INSECTS.

BLACK WALNUT CATERPILLAR (*Datana integerrima*). It was no uncommon sight this past season to see Black Walnut trees which had been wholly or partially defoliated by this caterpillar.

FALL WEB-WORM (*Hyphantria cunea*). The ugly nests of this insect were unusually abundant on shade and fruit trees. In several instances all the foliage on young trees was destroyed.

LINDEN INSECTS.

THE BASSWOOD LEAF-MINER (*Chalepus rubra*), and an undetermined species of lace-bug were very common on Linden in the Horticultural Experiment Station wood-lot.

MISCELLANEOUS PESTS.

ONION THRIPS (*Thrips tabaci*). What might have been a serious outbreak of onion thrips in the Horticultural Experiment Station vegetable gardens was kept within bounds by the effective work of a predaceous flower bug, *Triphleps tristicolor*, B. Wh.

Associated with *Thrips tabaci*, but not so numerous as it, was another species of *Thysanoptera*, viz.: *Aeolothrips fasciatus*.

POTATO BEETLE (*Leptinotarsa decemlineata*). This well known pest was more abundant around Vineland this past season than it has been for the last three years.

HORSE FLIES. During the hot weather of July and early August the green-headed horse fly, *Tabanus costalis*, was remarkably abundant and unusually troublesome.

THE CLOVER MITE (*Bryobia pratensis*). Early in June I received an urgent call from a horrified householder in Vineland to help him to expel or to exterminate certain minute horrors which had invaded his "best" bedroom. On visiting the house I found the bed clothes in the infested room literally alive with clover mites. As the invaders were in possession of the bed only, I suggested the immediate removal of the mattress and clothes to the lawn. This was done. The mattress was aired for some time, the bed clothes were laundered and nothing more was seen of the mites.

SCARRED APPLES.

Last month a local fruit grower drew my attention to a peculiar type of insect injury which was very common on the fruit of several Rhode Island Greening trees. The apples were marked here and there with calloused blemishes, which varied in shape from dots to long, irregular, serpentine areas. Although the blemishes were only skin deep they were sufficient in themselves to degrade No. 1 fruit to No. 3.

SCARRED APPLE.

As I was unable to determine the cause of the injury I submitted specimens to Profs. Caesar and Parrott, but neither could diagnose the trouble. Prof. Parrott's answer to my inquiry is quoted herewith:

"I am by no means certain as to the cause of the injury. During the past year we have discovered such injury upon apples, and specimens of peaches have

been forwarded to us injured in a manner quite similar. I spoke to Mr. Knight of Cornell University regarding the damage and he intimates that such injuries may attend the work of red bugs. In the specimens of fruit that have been sent to us from New York it is certain that the apples were first punctured by either red bug or an insect with similar habits. However, the remarkable thing about the injury is the development of a large irregular callous that stands out in marked contrast to the normal epidermis of the fruit."

I have brought some of the scarred apples along with me for your examination and I hope that some one present will be able to enlighten me as to the cause of the injury.

THE NATURALIST IN THE CITY.

REV. THOMAS W. FYLES, D.C.L., OTTAWA.

The lover of nature, whose avocations or infirmities limit his field of observation, may yet have opportunities for gratifying his tendencies, and adding to his knowledge of living things.

With your permission I will tell briefly of a few creatures that have engaged my attention during the periods of my life in cities.

In a paper I read before the Society last year, I told of an assembly of *Thalessa lunator* Fab. upon a scar on a limb of a Red Maple growing beside the house I now occupy. Early in the present year (1916), a strong gust of wind took the limb I speak of and snapt it off at the injured part. On examining it I found that decayed wood extended for at least two feet from the point of fracture. This touch-wood presented an interesting appearance. In it were the tunnels formed by *Tremex columba* Linn., closely packed with frass for much of their length. In them the larvæ of *Thalessa lunator* had found and devoured their prey. There were other tunnels (some of which opened out into those of the Tremex) and these were stored with dead flies of various kinds. Among the flies were the capsule-like cases, or cocoons of a species of wasp. They somewhat resembled the cocoons of the mud-wasp, *Pelopæus cementarius* Drury; but whereas the Pelopæus cocoons were brown and semi-transparent, showing the insect within, these were of a clay-yellow and opaque. They were also somewhat smaller.

At intervals in the beginning of June there came from these cocoons specimens of *Crabro singularis* Smith.

I also found in the decayed wood the mangled remains of *Tibicen rimosa* Say.

The fate of the fine limb of the shade tree I have spoken of should be a warning against injudicious pruning.

In my studies of the Mud-daubing Wasps I have been able to follow the life-history of *Pelopæus coeruleus* Linn. This is a more compact insect than *cementarius*, and in hue it is of a brilliant royal purple. Its cells resemble those of *cementarius*, and are found in association with them. The perfect insects, about the first week of July, bite neat round ways of exit from their winter prisons, and commence active operations very soon after. They are industrious collectors of spiders. I have counted as many as nine spiders in one of their cells. One egg only is laid by the mother wasp in each cell, and the grub that comes from it feeds upon the spiders. It is full-fed by the end of August and commences to spin its cocoon. The grub is of the usual sphex shape—somewhat attenuated towards the head, which is small and has dark nippers. The cocoon resembles that of

cementarius. In it the larva remains quiescent through the winter. In June the larval skin shrivels up, and the pupa, a wonderfully beautiful object, appears. It is as if it were formed of the purest translucent white wax. Its various parts are exquisitely fashioned, and symmetrically arranged. Towards the end of June the pupa begins to take colour: the eyes assume a pale chestnut tint—this changes to black. The thorax and wing-cases also become deep black. In the first week of July the complete metamorphosis has taken place, and the perfect insect comes forth in all its beauty.

I have mentioned *Tibicen rimosa* Say. This is a rare insect in Quebec Province, but its near relative *Cicada canicularis* Harris is very abundant.

One afternoon, in the early sixties, I was walking under a row of noble elm trees that grew along one of the upper-town streets of Montreal, when I noticed a large insect of rather a disreputable appearance crawl from the earth and begin to ascend a tree. Its proceedings interested me. After climbing for a foot it dug its claws—and it was well provided with claws—into the bark of the tree, to secure its hold, and then began to sway itself violently from side to side, as if troubled with a sharp internal disorder. Something will result from this paroxysm, I thought to myself, and something did result. Its skin parted along the back, from face to abdomen, and then the creature began to crawl through the gap it had made, drawing its legs from their cases as if it were taking off its boots. Its wings, which had been neatly plaited in side cases, were gradually unfolded, and in a quarter of an hour the perfect insect seemed to be ready for flight.

That large insects, such as *C. canicularis*, where they are present in numbers, must damage the trees by tunneling in them is evident. In passing, and by way of bringing this home, let me say, that, in my grounds at South Quebec there stood, in the open, a well-grown, shapely spruce—I suppose fifteen inches in diameter at the base. One windy day in the summer the tree broke off at the base. It was pierced, in every direction, by the mines of the "Forgeron" (as the French call it—the Blacksmith (*Monohammus scutellatus* Say), the black, titillating beetle, with the white lunette on its shoulders.

Leaving the insects let us for a few minutes consider some of the birds that frequent the city or occasionally visit it.

Last year, in the month of June, a young Night-hawk (*Chordeiles virginianus* Linn.) fluttered down from the flat roof of the after part of the house I now occupy on Frank Street, Ottawa. It lit upon the kitchen door-steps. When approached it merely cowered down, and then, without a struggle, allowed itself to be carried back to the roof from which it had fallen. A few days after another young bird, a male of the same species, tumbled to the same spot. I secured it with my entomological net, carried it up-stairs and let it go through a window. It partly opened its great length of wing and shuffled away behind a chimney.

The past summer was marked by frequent thunder-storms. On the 25th of June there was one of extreme violence. A stately elm, that grew in the vacant ground behind my house, was rent, through the centre, from top to bottom, by a lightning flash. When the storm was at its height I looked out upon the roof I have spoken of, and I was startled. Within three yards of me was a female Night-hawk sheltering her young with her ample wings. The rain descended in torrents, but, with marvellous patience, she maintained her position.

The greys and browns of the night-hawk's plumage, together with its white markings, blend with the tints of the pebbled roof of the city dwelling—or those of the waste place in the country—which the mother bird may select on which to deposit her eggs. The eggs resemble pebbles.

Another bird, the plumage of which befits its customary haunts, is the Ruffed Grouse (*Bonasa umbellus togata* (Linn.) Ridgw.). The females of this species when brooding on their nests are no doubt often saved from molestation by their colouring and the death-like stillness that they keep when foes are near.

The Ruffed Grouse (in the vernacular—*Partridge*) is not a familiar object in our city streets; but some years ago, when my home was in Hull, P.Q., I, one day, received a great surprise: I looked from an upper window and saw, amidst the potted plants on the roof of the balcony to my front door, standing in alert attitude, with outstretched neck, a Grouse.

So perfect was the bird in form and plumage that I could not think it had passed through the hands of a taxidermist; so motionless was it that I was doubtful whether it was really alive. My attention was called off for a few moments, and the bird seized the opportunity to fly away. How can I account for its presence? In this way:

Behind my house ran the creek which surrounds the City of Hull, and beyond it were the beautiful grounds of Mrs. Ellery Lord and Front Street. Then came the meadows (including the well-known "Beaver Meadow") and strips of woodland. Surveyors and axe-men had just commenced to convert the Beaver Meadow into town lots. Their operations probably had disturbed the grouse, and a succession of alarms had kept it on the wing till it whirled round the street corner near my house and took refuge in the greenery on the balcony. This, of course, is supposition.

One of our most welcome summer visitors is the robin. When friends meet, a frequent greeting in the end of April or beginning of May, is "Good morning! Did you hear the Robin?" What accounts for the popularity of the bird? (1) Its hearty morning call is a pleasant sound. (2) It is a trim, handsome bird, that adorns our city grass plants. (3) It is a sociable bird and loves to build its nest on or near our dwellings. (4) It is a cleanly bird and makes no litter in building, and keeps its nest and its surroundings unsullied. Its confidence in man wins man's protection.

A friend in Hull has under the veranda of his house a preserved head of a Virginia Deer. Between the horns of this, in the year 1909, a pair of robins built their nest and reared their brood. The same pair (it is thought) returned to it the next season and were again successful and raised their young.

It was interesting to watch the approach of a parent bird to the nest. It would alight on a branch of a cedar tree that grew at the end of the veranda and look around. If only members of the household were near it would come on at once. If a stranger were present it would pause, as if to judge of his disposition, before making its approach.

Of quadrupeds, perhaps the most rémarkable I have seen in a Canadian city is the Black Rat (*Mus rattus*). The specimen I found was a dead one. I had occasion one day to go to the Louise Embankment, Quebec City, and while walking along one of its wharves I found the body of the little beast I speak of (I am sorry that I did not have it preserved). The creature had probably landed from a vessel from Europe, and been set upon and killed by the Brown Rats with which the Embankment abounds.

The Black Rat, in olden times, was the common rat of England, and it was plentiful enough. Its enemy, the Brown or Norway Rat (*Mus decumanus*) found its way to that country about the period of the English revolution, and the Jacobites called it the *Hanover* rat, very much in the same spirit that *Cecidomyia destructor*

was called in America the *Hessian* fly. The Black Rat is a great rarity in England now.

The Flying Squirrels are interesting little animals. I purchased a pair of them in Bonsecour Market, Montreal, from a farmer's boy. This was in 1863. I carried the little creatures home and they became great pets. They slept curled up in their snuggery most of the day, but at dusk they became very lively. We were accustomed to open their cage door and let them have the run of two adjoining rooms. They would leap from piece to piece of the furniture in the rooms, and from picture to picture on the walls, and have a grand chase and frolic. When tired they would go back to their cage of their own accord. Unfortunately, one evening, our maid left a window open in the outer room, and our pets bounded through it and we saw them again no more.

Seals sometimes come up the St. Lawrence as far as Montreal. On the 23rd of April, 1863, I travelled to Laprairie. My business accomplished I hired a French Canadian and his son to row me back to the city in their canoe. The weather was delightful and the water calm. Masses of ice were floating about and wild ducks were flitting near. When we were drawing nigh the city a round head suddenly rose from the water not far away. "*Sacré!*" cried my old boatman "*Un veau marin! Un veau marin!*" Then breaking into English for the benefit of his passenger, "She am worth five *ou* six dollare. *He 'ts*, me gun she gone home!" Presently we saw another head. *Two* seals, attracted, the old man said, by his red shirt, were following us. We had their company for nearly a mile.

I have said enough, I trust, to remind you that, to those who have eyes to see, nature affords tokens of her presence, even in the busy haunts of men.

Dr. Hewitt: I think we should send Dr. Fyles the greetings of the Society, and also its thanks for the paper that he has contributed this afternoon. Dr. Fyles has always been present at every meeting of the Society that he could possibly attend. He has become so infirm now that he cannot move from his home at times, and therefore I think it is only right for us to send Dr. Fyles our greetings and thanks for the paper.

Mr. Winn: In Dr. Fyles' paper mention is made of the emergence of the Cicada. It has often been stated that the Cicada comes out early in the morning, but how long it takes to dry its wings is a matter of dispute.

Capt. Spencer: This summer I watched a Cicada emerge later than two o'clock in the afternoon at Camp Borden. It crawled out of the ground, left its case, and its wings were hard enough to fly a short distance (two or three feet) within half an hour.

DUSTING FRUIT TREES AND GRAPES FOR THE CONTROL OF DISEASES AND BITING INSECTS.

L. Caesar, O. A. College, Guelph.

The success of the Cornell experiments with the so-called "Dust Spray" aroused much interest in Ontario as well as elsewhere, and led to our performing a series of tests with this new method of controlling biting insects and diseases. All these experiments were conducted in the Niagara District, because I considered this not only the most convenient place, but also the district most infested with Codling Moth.

Composition of the Substance Used in Dusting.

In all my tests where both insects and diseases were to be combated, I used a mixture composed of 85 per cent very finely ground sulphur and 15 per cent. arsenate of lead powder, supplied ready mixed by The Niagara Brand Spray Co., Burlington. The price of the mixture was $6.50 per 100 lbs. When biting insects were not present, as on grapes, and on plums in the later sprayings, the arsenate of lead was omitted and finely ground sulphur alone used. This reduced the cost greatly as the sulphur alone cost only $2.90 per 100 lbs. Some persons used the sulphur mixed with finely ground limestone.

Outfit for Applying the Dust.

I had the larger type of dusting outfit supplied by the Niagara Brand Spray Co. They have a smaller outfit, but it cannot cover nearly so may trees. The outfit consists of a 2½ horse-power gasoline engine, a blower and a receptacle or

Dusting fruit trees for insects and diseases.

hopper capable of holding about 100 lbs. of the dust. The dust is blown out upon the trees through a galvanized iron pipe of about 3 inches diameter. This pipe is connected wth the blast passage by a thick rubber tube of the same diameter. The flexibility of the rubber allows the operator to direct the pipe in any direction quickly and easily. For small trees a short pipe about 3 feet long is used, but for large trees the pipe must be longer. I used one about 6 feet in length. Too long a pipe is awkward as the branches interfere with it; too short will not throw the dust high enough. The amount of material used can be regulated by the operator by a small lever on the hopper. The outfit costs complete about $265.

Kinds of Weather Best Suited for Dusting.

Dusting should not be done in a strong wind, because this carries the material too rapidly through the air instead of allowing it to float slowly through the trees and settle thickly upon the foliage and fruit. A strong wind, moreover, will often

drive the dust down and not permit it to reach the top of the tree. The ideal condition is a perfectly calm day, or one with almost no breeze. The driver should go up and down the rows parallel with the wind so that the operator may shoot the spray into the trees at right angles to the row, thus finishing the whole orchard as he goes. It will not do to dust one side of the trees; both must be done just as in the case of the liquid spray; otherwise the results will not be satisfactory. Sometimes, especially at the Codling Moth spray, it is impossible to watch for an ideal day, and one has to spray with the wind. Then if it does not change soon, the remainder of the tree can be sprayed by blowing the dust in from each side at right angles to the wind. The spraying may be done in the morning or evening when the wind usually moderates.

It is just possible that grapes in the earlier dustings before the leaves are large and abundant could be dusted against the wind so that the dust would be blown back to the opposite side of the next row, in this way covering both sides and saving time and labor. This cannot be done, however, when the foliage is dense.

Dusting apparently may be done with safety either when the foliage is dry or moist.

Amount of Material Required Per Tree.

For very large apple trees requiring about 12 gals. per tree of liquid for the Codling Moth spray, I use an average of nearly 4 lbs., but found that 3 lbs. would, if properly applied, suffice. For an average size apple tree about 25 years of age, I should use at least 2 lbs. Plum, cherry and peach trees require anywhere from about $\frac{1}{4}$ to 2 lbs. per tree. It requires a good deal of careful watchfulness to determine how much to use. A careless man may use 100 lbs. in a few minutes, where one-quarter the amount would have been sufficient.

Need of Care in Applying the Dust.

I found that to cover either a large or small tree thoroughly with the minimum loss of material required much quickness of movement and constant watchfulness. It is no job for a lazy or an indifferent man. As a rule the best method was to move the outlet pipe up and down quickly, and not to drive so close to the tree that the branches would be in the way. This, however, often had to be varied for a sudden gust of wind from time to time would carry the dust away from the desired direction. This necessitated a different stroke to cover the missed area. Sometimes too, the branches were too close to spray them except by shooting the dust back quickly when the wagon had passed. One would be very tired after a hard day of careful dusting of large trees.

There is very little danger to the operator from the dust, but it is expedient to use goggles.

Comparison of Time Required for Dusting vs. the Usual Method of Spraying With a Power Machine.

The dusting method is very much quicker than the other method. It took me an average of $1\frac{1}{2}$ hours to spray both sides of 92 very large apple trees. With a power outfit and liquid spray applying 960 gals. per day, it would have taken at least 12 hours to do the work as thoroughly. This means that on such trees the dust spray was eight times the more rapid. On smaller trees, such as plums or cherries, which with a liquid outfit may be well sprayed as the horses move slowly

but continuously along, the advantage in saving of time would not be great were it not that it takes a good while to fill up the tank with liquid, whereas it requires only a minute or two to fill the hopper with dust. On these small trees the dust method would probably be from two to four times as rapid as the liquid.

Comparison of Cost on Large Trees.

The following data for the large apple trees sprayed by us give what I believe to be a fairly accurate estimate of the cost of each kind of spraying where there are no delays of any kind, and where both outfits are working well in every way.

Cost of Dusting 92 Large Apple Trees Using 3 lbs. per Tree.

92 large apple trees at 3 lbs. each = 276 lbs. material at 6½c.	$17.94	
Gasoline at 35c. per gal.	.15	
Oil	.04	
2 men at 20c. per hour, for 1½ hours	.60	
1 team at 30c. per hour, for 1½ hours	.45	
Total cost for 92 trees	$19.18	
Average cost per tree		20.8c.

Cost of Spraying 51 Large Trees with Lime-Sulphur and Arsenate of Lead.

612 gals. dilute lime-sulphur (strength 1.008 sp. gr) = 16½ gals. commercial lime-sulphur at 15c. a gal.	$2.46	
30½ lbs. arsenate of lead at 11c.	3 36	
Gasoline	60	
Oil	15	
3 men for 6⅜ hours at 20c.	3 82	
1 team for 6⅜ hours at 30c.	1 91	
Total cost for 51 trees	$12 30	
Average cost per tree		24.1c.
Average cost for dusting		20.8c.
Balance per tree in favour of dust		3.3c.

COMPARISON OF COST ON LARGE, SWEET CHERRY TREES.

Cost of Dusting 55 Large Trees.

100 lbs. dust at 6½c. per lb.	$6 50	
Gasoline	05	
Oil	20	
2 men ½ hour at 20c.	20	
1 team ½ hour at 30c.	15	
Total cost of 55 trees	$6 92	
Average cost per tree		12.6c.

Cost of Spraying 45 Trees with Lime-Sulphur and Arsenate of Lead.

160 gals. lime-sulphur (strength 1.008) = approximately 4⅓ gals. commercial lime-sulphur at 15c.	$0 65	
10 lbs. arsenate of lead at 11c.	1 10	
3 men, 1½ hours at 20c.	90	
I team, 1½ hours at 30c.	45	
Gasoline	15	
Oil	05	
Total cost for 45 trees	$3 30	
Average cost per tree		7.3c.
Average cost for dust per tree		12.6c.
Balance in favour of liquid per tree		5.3c.

The balance in favour of the liquid would be still greater on small trees taking less material. If, however, the arsenate of lead were omitted the dust price would fall from 12.6c to 6c and the liquid from 7.3c to 5c, leaving the liquid still the cheaper.

One must not forget that all the above figures are based on the assumption that the outfit used for the liquid spray was a power one, applying 960 gals. per day of 10 hours, whereas many of our fruit-growers still use the hand pumps, which take double the amount of time, and would thus increase the cost in comparison with the dusting, though the initial difference in price of the two outfits would offset much of this.

Experiments on Large Apple Trees.

The orchard chosen for the experiments consisted of 162 very large trees almost any one of which was capable of bearing 10 barrels and upwards of fruit. The varieties were Baldwin, Greening, Golden Russet, Spy, Yellow Harvest, Astrachan, Gravenstein and Twenty-ounce Pippin. The orchard was in a neglected condition, and had not been sprayed for years. All the trees were infested with San José Scale, some of them badly. Codling Moth abounded in this and other unsprayed or poorly sprayed orchards of the district, and as the trees extended up to the base of the so-called Mountain, which was covered with uncared for apple, pear, plum and cherry trees, and also with many shrubs and weeds, the Plum Curculio was more abundant here than in most orchards. The leaves on the ground in spring, as examined by Prof. Howitt and myself, showed great numbers of the perithecia of the Apple Scab fungus.

Before the spraying, the owner of the orchard pruned the trees moderately well, and scraped off the rough bark. Then in order to give the different substances used a fair chance, we sprayed the whole orchard heavily for San José Scale with lime-sulphur, strength 1.035 except that soluble sulphur was used on 19 trees (strength 12½ lbs. to 40 gals.). About half the dust plot was sprayed for scale before the buds began to burst, the remainder and most of the liquid plots as or just after the buds burst. Buds began to open May 2nd. All plots were finished by May 5th. The spraying for the scale gave satisfactory results on all except six trees which, owing to their situation, could not be thoroughly treated. Out of the total of 162 trees, 92 which formed a block by themselves east of the house were chosen for the dust test, and the remaining 70 were used for the liquid sprays. Of these 70 we chose four central rows containing the 19 trees mentioned above for a comparative test with soluble sulphur and calcium arsenate. The rest (51 trees) were treated with lime-sulphur and paste arsenate of lead.

The Dusted Plot (92 trees).

The trees were each dusted twice, the work being thoroughly done on both occasions. On August 22nd, 61 trees were redusted on one side only, but as this partial application had no visible effect on the trees compared with the remainder either upon insects or diseases, it need not be considered.

The first dust application was just as the blossom buds were ready to burst, May 19th and 20th. I delayed it just as long as I could and until a few blossoms had actually opened. The dust, therefore, had an excellent opportunity to get on the base or receptacle of the blossom and protect it against early infection with Scab.

The second application was soon after the blossoms fell. One side of the trees was dusted June 3rd, the other June 6th. The calyces were beginning to close at the latter date, but were not too far advanced for best results,

THE LIME-SULPHUR AND ARSENATE OF LEAD PLOT (51 trees).

The first application after the leaves opened was, as in the case of the dust, given just before the blossoms opened, one side of the trees being done on May 15th, and the other on May 20th. The lime-sulphur was used at the strength of 1.010 sp. gr. and the arsenate of lead (paste) at $2\frac{1}{2}$ lbs. to 40 gals. of diluted lime-sulphur.

The second application was given soon after the blossoms fell, one side of the trees being done on June 1st, the other on June 3rd. The lime-sulphur was used at the strength of 1.008 sp. gr. and the arsenate of lead (paste) at 2 lbs. to 40 gals. of diluted lime-sulphur.

THE SOLUBLE-SULPHUR AND CALCIUM ARSENATE PLOT (19 trees).

The first application was just before the blossoms burst, one side May 17th, the other May 20th. Soluble-sulphur $1\frac{1}{2}$ lbs. and calcium arsenate (powder) 1-2/3 lbs. to 40 gals. of water were used.

The second application was just after the blossoms fell, on June 3rd, both sides being sprayed the same day. The soluble-sulphur was used at $1\frac{1}{4}$ lbs. and calcium arsenate at $1\frac{2}{3}$ lbs. to 40 gals. of water.

Note.—In each plot it will be observed that including the early application for San José Scale, only three sprayings were given, except that in the dust plot 61 trees were dusted from only one side in August.

TREATMENT OF SOIL ON THE PLOTS.

No part of the orchard received any fertilizer. The dusted part had rich soil and was left in sod, in fact two cows pastured on it for a couple of weeks while the apples were small. Later the weeds were mown down. The liquid sprayed part had poorer soil, hence the owner on our advice ploughed and cultivated it to give the trees a fair chance.

CHECK TREES.

As check trees we relied upon the uncared for trees on the mountain side, on neighboring orchards and on a row of ten trees consisting of R. I. Greening, Baldwin, Spy and Gravenstein, belonging to a neighbor, and in the same relative position to the mountain as our own orchard. These ten trees we dusted before the buds burst with soluble-sulphur dust and hydrated lime to see the effect upon San José Scale. Somewhat unfortunately for us, perhaps, the owner seeing the excellent amount of bloom gave the trees a moderate spraying with lime-sulphur and arsenate of lead soon after the blossoms fell.

RESULTS.

1. *Effect on the Foliage.*—We may mention here that on neither apples, cherries, plums, peaches nor grapes did the dust, so far as we could judge, cause any burning or injury. On the apple trees the dusted leaves were much superior to those on the liquid sprayed plots, being more glossy and more perfectly expanded than those that were sprayed with lime-sulphur and arsenate of lead. The soluble-

sulphur and calcium arsenate burned the foliage very severely, causing fully half of the leaves to drop and leaving dead spots on most of the remainder.

2. *Effect on Apple Scab.*—On each of the plots apple scab was well controlled. The liquid sprayed parts were a little better than the dusted, but not much. There is no doubt that fully 99 per cent. of the fruit in the lime-sulphur and arsenate of lead plot was free from scab. The soluble-sulphur and calcium arsenate plot gave at least 98 per cent. free and the dusted part averaged as nearly as we could judge 97 per cent., though one Greening tree situated at the extreme north-east corner where it was difficult to dust it thoroughly had about 10 per cent. scab, and a Spy tree possibly 8 per cent. A count at picking time of 1,500 apples on a dusted Yellow Harvest, a variety very subject to scab, gave 51 scabby apples, or 3.4 per cent., leaving 96.6 per cent. free of scab. A count of 400 Red Astrachans, nearly all there were, gave 12 scabby = 4 per cent., leaving 96 per cent. clean.

Neither my assistant nor I could be present at picking time owing to College duties, but we examined carefully at the end of August every Baldwin, Greening, Russet and Spy tree that had fruit on it on all the plots, and made a note of the number of scabby fruits on each. No further development of scab has taken place since. The results are shown in the following table.

TABLE SHOWING THE NUMBER OF SCABBY FRUITS AS SEEN ON THE TREES AT THE END OF AUGUST.

Variety	No. of Trees	Mixture used	No. of Scabby Fruits
R. I. Greening..........	12	Dust..................	120 (55 of these on one tree)
" "	12	Li-sul and arsenate of lead	10
" "	10	Sol-sul and calcium arsenate	38
Baldwin................	61	Dust	102
"	10	Sol-sul and arsenate of lead	1
"	6	Sol-sul and calcium arsenate	3
Golden Russet	3	Dust..................	4
" "	2	Li-sul and arsenate of lead	1
" "	2	Sol-sul and calcium arsenate	2
Spy	1	Dust..................	50
"	Part of 1 tree a graft	Li-sul and arsenate of lead	0

These figures do not of course represent the total number of scabby fruit, but we believe that they do represent at least half the total number. Since writing the above Mr. W. E. Biggar, the Provincial Fruit Pests Inspector, has counted many bushels of the dusted fruit picked from various trees and corroborates my estimate of the percentage of clean fruit. The dusted part of the orchard I estimated to have over 300 barrels of a crop, the other about 85. Some trees were heavily loaded, others very lightly.

Checks.—On the mountain side Baldwin trees averaged approximately 50 per cent. scabby fruit, Golden Russets approximately 10 per cent. There were no Greenings or Spys. On the row of ten trees on the adjoining farm, where the trees

received the Codling Moth spray, but not the one just before bloom, the Greenings and Spys averaged from 25 to 30 per cent. scabby fruit, and the Gravenstein 50 per cent. or upwards, while a heavily loaded Gravenstein in the dusted plot averaged 5 per cent. scab, but it should be mentioned that this tree, owing to its blooming earlier than the other trees of the orchard, had been sprayed with lime-sulphur three days before it was dusted. (The dust had not arrived yet).

An examination of many trees throughout the district led us to estimate that in general unsprayed Spy trees were about 60 per cent. infested with Scab, Greenings and Baldwins about 40 per cent. These figures show that in spite of the wet season, the scab fungus was not specially abundant in the Grimsby district, and therefore much better results were obtained by spraying there than would likely have been obtained in almost any other part of the Province. The average unsprayed orchard elsewhere would show 95 per cent. of scabby apples.

Another view of the dusting machine at work.

What has been said shows that dusting as done by me under Grimsby weather conditions, gave satisfactory results on Apple Scab, but I fear I could not have obtained nearly so good results in most, or perhaps, in any other part of the Province. Mr. Kydd, of the Fruit Branch, Toronto, who is just as thorough an experimenter as I am, did not secure nearly so good results from the dust spray as from the lime-sulphur liquid spray. The contrast is a striking one.

TABLE SHOWING RESULTS OBTAINED BY MR. W. F. KYDD.

Place	Variety	Mixture used	No. of applications	Scab-free Apples
Paris............	Spy	Lime-sulphur and arsenate of lead....................	4	95
"	"	Dust (sulphur and arsenate of lead, powder)	4	28
Wellington	"	Lime-sulphur and arsenate of lead....................	4	83
"	"	Dust (sulphur and arsenate of lead, powder)	4	24

The unsatisfactory results obtained by Mr. Kydd and, as I am informed, by many other men in the United States, show that it would be very unwise to recommend unreservedly the dust spray as a substitute for the lime-sulphur and arsenate of lead.

As weather conditions are the chief factors determining the amount of scab, I have inserted here the weather record from April 23rd to June 25th, during which time all the scab infection of the season took place.

	A.M.	P.M.	Temperatures		
			Maximum	Minimum	Precp'n.
April 23	Dull	Slight rain, dull	49	39	
24	Cloudy	Sunny and warmer	51	40	¾″
25	Cloudy	Cloudy, with little rain towards night	51	42	
26	Dull to clearing	Bright, distant thunder	57	41	
27	Fairly bright	Mostly bright, turning colder	52	42	
28	Early fog to 8 a.m., bright	Warm and bright	59	39	
29	Beautiful and bright	Sunny and warm	60	42	
30	Bright and pleasant	Mostly bright with few clouds	71	42	
May 1	Cloudy, with small amount of fog	Bright and windy, S.-W., light showers at night	72	45	
2	Bright and cool	Mostly bright, North breeze, apple leaf buds beginning to open	72	39	.10
3	Rain and cool, N.	Dull, very little rain and cool	72	37	.35
4	Bright and fair	Bright, W.	72	41	
5	Early morning bright, cloudy about 9 a.m., Strong S. winds	Some clouds	72	47	
6	Fairly bright, few clouds	Some clouds, but sunny at times	72	42	.20
7	Fine, warm and clear	Fine, warm and clear.	72.5	30	
8	Rain, clearing at 10 a.m.	Bright and breezy	70	43	.19
9	Bright and cool, W.	Bright, breezy, cool, W.	61	44	
10	Rain until 12 a.m.	Very little rain, mostly cloudy	70	45	.23
11	Bright and breezy	Bright and very windy, W.	68	29	
12	Bright and cool	Bright, breezy and slightly cool.	59	41	
13	Bright, cool breeze, E.	Bright and warm	66	37	
14	Dull and cool	Rain all p.m.	65	43	.22
15	Rain 5 to 8 a.m., turning brighter	Dull, misty, damp	50	41	.97
16	Very light showers in early morning	Rain all p.m., moderately heavy	56	43	.14
17	Cold, cloudy and damp,	Cloudy, colder and windy	56	45	.07
18	Cloudy, windy & chilly.	Cloudy, windy & chilly	55	40	
19	Cleared about 8 a.m.	Clear	62	40	.11
20	Bright and fairly warm	Bright and fairly warm	60	38	
21	Bright and fairly warm	Bright, turning cloudy.	60	39	

	A.M.	P.M.	Temperatures Maximum	Minimum	Precp'n.
22	Rain	Rain	58	43	.44
23	Dull till 9 a.m.	Clear and warm	75	45	.13
24	Clear and warm	Clear and warm	78	49	
25	Warm, few clouds	Warm, few clouds	72	56	
26	Bright and warm	Bright and warm	63	46	
27	Heavy thunderstorm, 5 to 8 a.m.	mostly cloudy	62	44	.42
28	Bright and clear	Bright and clear	76	46	
29	Bright and clear	Bright and clear, began to rain at 6 p.m.	60	51	
30	Heavy rain during night, cloudy	Mostly hot and bright.	62	51	1.36
31	Clear and cool	Clear and cool	64	45	
June 1	Clear and fine	Clear and fine	65	41	
2	Rain at 10 a.m.	Rain, heavy	69	44	1.43
3	Clearing	Fine	68	51.5	.10
4	Bright	Mostly bright	70	51	
5	Bright	Bright	70	54	.16
6	Fair	Fair, E.	61	47	
7	Cloudy	Heavy rain	64	48.5	.12
8	Dull and cool	Rain and dull	61	52	.17
9	Sunny	Dull with showers, rain at night	55	44	.53
10	Cloudy	Dull	58.5	50	.01
11	Fair	Fair	60	46	.03
12	Clear and fine	Clear and fine	73	48	
13	Clear and hot	Clear and hot	80	54	
14	Clear and warm	Clear and warm	79	56	
15	Rather dull	Rain 1.30 to 3.30 p.m.	72.5	60	.08
16	Cloudy	Cloudy, cooler at night	66.5	50	
17	Fine and warm	Fine and warm	70	50	
18	Dull with some rain	Dull with some rain	62	56	.66
19	Dull with some rain	Clearing	64	49	.29
20	Cloudy and cool	Cloudy and cool	58	49	
21	Rain, clearing at 11 a.m.	Clear	61.5	47	.16
22	Bright	Bright	69	46	
23	Fair	Fair	66	47	
24	Fair	Heavy rain, 4 to 5 p.m.	65	56	.83
25			68	55	

Fine dry spell began here.

3. *Effect on Leaf-Spot.*—Experiments performed by Mr. W. F. Kydd, of the Horticultural Branch, in an orchard at Wellington this year, showed that the dormant spray, or the spray as the buds are bursting, has much value in the control of leaf-spot, and hence in our plots the spray for the San José Scale doubtless helped. In the dusted parts we saw no leaf-spot. The lime-sulphur part was also almost entirely free, and any slight amount there was may have been due not to the fungus, but to burning by the mixture. On the soluble-sulphur and calcium arsenate plot, the spray injury was so great as to make it impossible to determine anything about this disease. On unsprayed trees there was a considerable amount of leaf-spot, but we did not estimate the percentage, as this disease is not of much importance in Ontario.

4. *Codling Moth.*—On all the plots the Codling Moth was well controlled, especially when we consider that the orchard had been neglected for several years. Only two apples in the whole orchard were found in which the worms had entered

the calyx end. There were a number of side worms, but not so many as we expected. My estimate made the first week in October for the total of the fruit both on the trees and the ground was that it ran somewhere between 5 and 10 per cent., with an average of probably 8 per cent. There was very little difference between the different plots.

Check trees and poorly sprayed orchards nearby varied from 30 per cent. to 80 per cent. wormy with about 75 per cent. of these entering at the calyx end. It is quite clear, therefore, that the dusting will control the Codling Moth satisfactorily.

5. *The Plum Curculio.*—With the exception of one or two rows of trees bordering upon the mountain, and in some thickets along one side of the dusted part of the orchard Curculio injuries were scarce. Even on the worst infested trees much fewer apples dropped or were deformed than I had expected. The vigorous condition of the trees may have had something to do with this. The liquid sprayed part was freest from Curculio injuries, but owing to a difference in surroundings it is impossible to determine whether the spraying was the cause. The check trees were much worse infested, but in most cases their surroundings were more favorable for these insects.

6. *Other Biting Insects.*—All the plots were to some extent infested with Fall Cankerworms, Bud-moth, Case-bearers and Lesser Apple-worms. The percentage of these killed could not with the time at our disposal be determined; there was, however, not much difference in the amount of injury done in the various plots.

Results on Sweet Cherries, Plums, Peaches and Grapes.

As very few of the members of our Society, or of the others present are specially interested in plant diseases, I shall not go into details of the experiments with the dust on plums, peaches, cherries and grapes, but merely state that on sweet cherries, which are much more subject to rot than sour, the dust spray gave about equally as good results as either lime-sulphur or Bordeaux mixture, and that all these plots were much cleaner than the check. On plums (Lombard variety) the rot was controlled. On the checks of the same variety there was considerable rot. On peaches there was so little rot even on the unsprayed trees that no conclusions could be drawn.

On Roger varieties of grapes, which are of course specially subject to Powdery Mildew, this disease was thoroughly controlled, whereas on checks there was considerable of the disease both on the leaves and berries. The season was, however, not specially favorable for Mildew, and there was almost no Black Rot.

Conclusions.

My results with the dust spray apply only to Grimsby district and Grimsby weather conditions. I have some doubt whether in other districts with the closest study of the weather and a good knowledge of the life history of the apple scab fungus, I could have so chosen the dates and numbers of application as to control the scab on apples. It is certain that in some places the ordinary recommendations would have had to be modified.

A great drawback to the dust method is that we have not yet found a really satisfactory powder that will control scale insects or other sucking insects. Finely ground soluble-sulphur mixed with hydrated lime gave me fairly good results on San José Scale, but there is almost sure to be trouble with this mixture, because of its tendency to absorb moisture and then harden, thus clogging the slit in the

hopper and the blast passage. It seems necessary also to apply it to the trees when they are moist. Another defect is that the dust does not adhere nearly so well as the liquid lime-sulphur especially on glossy fruits and foliage. This is somewhat counteracted by the fact that one can use the dust on fruit a short time before picking without fear of staining, but cannot do this with the liquid.

I believe that some tests on Pear Psylla at Burlington, probably with hydrated lime, have proved successful.

I am also told that some tests in New York, possibly with tobacco dust, promise well against aphids.

Should the hopes of the advocates of the dusting method of spraying be realized we can see a great field of usefulness for it not only on fruit trees, especially large fruit trees, but also on valuable shade trees in cities and parks. It should be a great boon in the control of the Elm Leaf-beetle, Tussock Moth, Tent Caterpillars, and many other biting insects. Leaf diseases on shade trees could also in some cases be controlled. I believe it has already been tested on the Leaf-spot or Leaf-blight of the horse chestnut.

It should not be at all difficult to improve the outfit so that even the tallest trees could easily be reached.

Father Leopold: May I ask Prof. Caesar what is the cost of your spraying outfit, that is, for the blower alone?

Prof. Caesar: The total cost for engine, blower and hopper was $260; it will be a little higher this next year, probably $275. Probably $150 or $140 would be the price for the blower and the hopper; I think you could get the engine for about $100.

A Member: What horse-power engine did you use?

Prof. Caesar: Two and one-half horse-power.

Prof. Brittain: Did you have anyone here contract lead poisoning from the use of that dust mixture?

Prof. Caesar: There would be a possibility of injury from the dust if you were reckless and tried to spray against the breeze, but the spraying should always be done, if possible, on a calm day, and you should spray at right angles to any little wind there may be.

Prof. Brittain: I have been told of one experimenter who contracted a very bad case of lead poisoning from using the dust spray.

Prof. Caesar: I sprayed a good many days this year, and I consider that the danger from the dust amounts to practically nothing both to the eyes and to the lungs. I should say, however, that I wore goggles part of the time.

Prof. Brittain: I should think that the great weakness with this dust spray would be that it does not control sucking insects successfully. Where scale insects and sucking insects like Capsids are very abundant, that would be a very serious drawback.

Prof. Caesar: In a large part of Ontario we do not need to spray for Aphids and our Capsids, though they are bad in a few orchards, are very seldom bad enough to necessitate spraying for them.

Mr. Dearness: I understood Prof. Caesar to say that the spraying for Scab was done at an exceptionally favourable time, and I wish to ask what time that was.

Prof. Caesar: The Apple Scab is of course one of the interesting things from the standpoint of plant pathology. I found in our experiments—and I have been spraying for Apple Scab for eight years—that the great danger period for Apple Scab is either the period from the time the blossoms begin to burst on to

the time when the apples are about the size of a good marble (about half an inch in diameter), or from about the middle of August to the time of picking. The first period I have mentioned you will find will be the one for about five seasons out of six. I have never sprayed more than three times. If you have your orchard perfectly clean for the first period, it takes a long time for the scab fungus to become abundant again that year.

Mr. Dearness: In regard to the scattering of the summer spores, do you find this to be about the first of July? This fungus has its first period of infection, of course, directly from the over-wintering spores.

Prof. Caesar: I may say in regard to the times of infection that the first infection comes on the leaves nearly always, and it comes from the ascospores on the leaves on the ground. As soon as those develop to fructification—which is in about two weeks usually—you have then what you call the summer spores. You can never be sure of the date; it depends upon the weather conditions.

Mr. Biggar: Has the dormant spray anything to do with the control of Scab?

Prof. Caesar: Some seasons it has, and I think probably in our case it had because we gave a very heavy application for San José Scale, and everything on the ground was drenched.

GENERAL NOTES ON APHIDES WHICH OCCUR ON APPLE TREES.

William A. Ross, Vineland Station.

The purpose of this paper is to present brief notes on ten species of aphides which have been taken on the apple in Ontario. Four of the insects, viz., *Aphis pomi*, *Aphis malifoliæ*, *Aphis avenæ* and *Eriosoma lanigera*, are noxious; the others, viz: *Aphis bakeri*, *Aphis brevis*, *Aphis* sp. (near *gossypii*), *Macrosiphum solanifolii*, *Myzus persicæ* and *Macrosiphum pelargonii* (?) are, so far as our observations have gone, of little or no economic importance.

The Green Apple Aphis (*Aphis pomi* De Geer). This species is the most troublesome plant-louse with which Ontario orchardists and nurserymen have to contend. It attacks, curls and sometimes kills the foliage, and in cases of severe infestation, it may even feed on the fruit. It has a very pronounced predilection for succulent shoots and water sprouts, and in fact, if not provided with these delicacies, it will not thrive and multiply rapidly. The aphis produces a generous supply of honey-dew, and because of this it is well patronized by ants. The black fungus which develops in this honey-dew gives the foliage, twigs and sometimes the fruit of an infested tree a sooty and very unsightly appearance.

The eggs of *Aphis pomi* hatch in April when the buds of apple trees are swelling and commencing to burst. The stem-mothers, *i.e.*, the aphides which hatch from the eggs, reach maturity, and commence reproducing in somewhat less than three weeks. During the next month or so each female which survives all the perils to which plant-lice are subject, gives birth on an average to 70 young (74 was the average obtained from 18 individuals in our 1915 experiments). The progeny of the stem-mothers for the most part develop in from two to three weeks into apterous viviparæ. A number of this generation, however, and a still larger number of the third generation become alate and migrate to other apple trees. The third generation is succeeded by brood after brood of wingless and winged viviparæ until by the close of the season as many as fourteen or fifteen generations

may have arisen. In the fall, apterous oviparæ and apterous males put in an appearance. The sexes mate and the females deposit their eggs on twigs and water sprouts.

THE ROSY APPLE APHIS (*Aphis malifoliæ* Fitch). Like many another rogue, this insect has been living amongst us under a false name. In a recent letter, Mr. A. C. Baker, of the U. S. Bureau of Entomology, informs me that its correct appellation is *Aphis malifolia* Fitch, and not *A. sorbi*, nor yet the more recent *A. kochii*. It appears that Kaltenbach's *A. sorbi* from Sorbus and Schouteden's *kochii* (*pyri* Koch) from apple are quite distinct from our rosy aphis.

This species is often very destructive in apple orchards. It has a marked preference for, and confines its work largely to the lower, inner and shady portions of the trees. It not only curls and destroys foliage, but by feeding on the leaves adjacent to fruit clusters, and on the fruit itself, it produces bunches of deformed, dwarfed and unmarketable apples. The rosy aphis is essentially a pest of the bearing orchard. So far as our observations have gone, it seldom occurs on, and is never injurious to nursery stock. This partial immunity is largely due, I think, to the fact that young trees do not afford the aphis—a shade loving insect—suitable shady quarters.

The eggs of this species hatch about the same time as those of *Aphis pomi*. The stem-mothers become mature in twenty days or so, and begin to give birth to young at an alarming rate. According to our 1915 experiments each female may produce from 67 to 260 young (data obtained from 12 individuals). The second generation resemble their mothers to a great extent in rate of development, in fecundity and in the absence of wings. During a period extending from mid-June to the latter part of July, the third generation lice acquire wings and migrate to and establish colonies on *Plantago lanceolata*, and *P. major*, chiefly the former. (It should be mentioned here that a small percentage of the migrants may belong to the second and fourth generations). On the secondary food plants, the aphides breed rapidly, and as many as eleven broods may arise. In the autumn alate sexuparæ and alate males appear and fly back to the apple. The sexuparæ give birth to young, which in three or four weeks' time became mature apterous oviparæ. After being fertilized by the males the oviparæ lay their eggs on twigs and branches—in crevices and around the base of buds.

THE OAT APHIS (*Aphis avenæ* Fabricius). In the spring, this aphid, as a general rule, is much more abundant than the two preceding species, but as it only remains on the apple for a comparatively short time, it is not so injurious as they are. It attacks the foliage, the blossom stems, and sometimes the petals.

The eggs of the oat aphis commence to hatch several days before those of *Aphis pomi* and *Aphis malifoliæ*. The stem-mothers develop rapidly, and most of them are mature and are reproducing by the time the apple blossoms are showing pink. In the matter of reproductive capacity, they are very much like the stem-mothers of *A. pomi*—each female may give birth on an average to 76 young (average obtained from 9 individuals, 1915 experiments). The majority of the second and the whole of the third generation become alate, and during a period extending from mid-May to mid-June, migrate to their summer food plants—various grains and grasses. On these hosts, the aphides feed and breed until fall, at which time the return migration to apple takes place. As in the case of *malifoliæ*, the males are produced on the secondary, and the sexual females on the primary host.

THE WOOLLY APHIS OF THE APPLE (*Eriosoma lanigera* Hausmann). This cosmopolitan bark-feeding aphid is a very destructive apple pest in certain countries,

e.g., The United States, South Africa and England; however, in Ontario, fortunately for everyone concerned, it is only of minor importance. It is present in all our apple growing sections—on orchard and nursery tree, but it is seldom abundant and injurious enough to cause any alarm, or to warrant the adoption of remedial measures.

During the summer, colonies of flocculent apterous viviparæ occur on the twigs and water sprouts and around pruning wounds on the limbs and trunk. Rarely the lice are also found feeding on the roots of nursery stock, where they cause the formation of knotty enlargements. (Personally, I have never found the root-inhabiting aphides in Ontario. Nurserymen, however, inform me that they occasionally see them.) In September, alate forms appear and, according to Dr. E. Patch, of Maine, migrate to the American Elm, where they give birth to the sexes—minute wingless creatures. After mating, the females lay their eggs in crevices on the bark. The migration back to apple takes place in June of the following year.

THE CLOVER APHIS (*Aphis bakeri* Cowan). This plant-louse does not appear to be common in Ontario. Personally, I have only taken it thrice on apple. In Colorado, however, *A. bakeri*, according to Gillette and Taylor, "ranks next to the green apple aphis in numbers as a leaf infesting species of the apple."

As the name suggests, the clover aphis migrates from apple to clover.

Ontario collections: Migrants—Arkona, 6.10.16; Migrants and young—Vineland, 14.10.16 and 17.10.16.

THE LONG-BEAKED CLOVER APHIS (*Aphis brevis* Sanderson). This insect is essentially a hawthorn species, and it only occasionally occurs on apple. I have made but three collections of it from the latter host.

Like the preceding species, it spends the summer on clovers.

Ontario collections: Migrants and males—Vineland 3.11.15; Males—Arkona, 6.10.16; Migrants, males and immature oviparæ, Vineland 17.10.16.

Aphis sp. (*near gossypii*). In June, 1915, Mr. Howard Curran, my assistant, collected specimens of an unfamiliar, pale green aphid from an old apple tree growing on the O.A.C. campus at Guelph. According to Mr. Curran, the plant-louse was quite abundant at the time the collection was made.

This aphid is either a new species closely allied to *Aphis gossypii*, or it is a variety of the melon aphis. It differs from typical *A. gossypii* in having sensoria on antennal joint IV and sometimes on V, but whether this difference is of specific value I am at present not prepared to say. Only a careful study of the antennal variations of *A. gossypii* from different hosts will settle this point.

The following table affords a comparison between *Aphis* sp. and *Aphis gossypii* in the matter of antennal sensoria, and it likewise indicates the variability of the melon aphis.

Laboratory No.	Aphid	Sensoria on III	Sensoria on IV	Sensoria on V
6287.1......	Aphis sp.............................	7–11	3–6	0-2 and the sub-apical
——	Aphis gossypii as described by Pergande	5–7	None	Sub-apical
6287.4......	Aphis gossypii from cucumber	5–8	None	Sub-apical
6305........	Aphis gossypii from begonia............	6–8	0–1	Sub-apical
6294.3......	Aphis gossypii bred on apple	7–10	0–2	Sub-apical
6405........	Aphis gossypii bred on apple	8–11	0–2	Sub-apical

The Potato Aphis (*Macrosiphum solanifolii* Ashmead). Dr. E. Patch points out in her recent publication on the Pink and Green Aphis of the Potato, that this insect has a very varied dietary ranging from grasses to composites. In view of this, it is not at all surprising that the aphid sometimes feeds on the apple. I have two Ontario collections of it from this host. Mr. A. C. Baker, of the U. S. Bureau of Entomology, also records its occurrence on apple at Washington, D.C.

Ontario collections: Alatæ, apterous viviparæ and nymphs—Guelph. 20.6.15; Alate form—Vineland, Ont., 3.6.16.

The Peach Aphis (*Myzus persicæ* Sulzer). This very common general feeder has frequently been found feeding on apple seedlings growing in the Horticultural Experimental Station greenhouses at Vineland Station, Ont. Fall migrants and their young have also been taken on orchard trees. (Vineland, 1916).

The Geranium Aphis (*Macrosiphum pelargonii* Kalt). (?) Small colonies of a large green *Macrosiphum* were frequently found this spring on some seedling apples which we had growing in our greenhouse insectary at Vineland.

I cannot be positive about the identity of this louse, but I think it is *Macrosiphum pelargonii*. It differs from typical *pelargonii* in having the abdomen of the alate form ornamented with five transverse, broken, dark bands, but it is very questionable if this slight difference has any specific significance.

Prof. Brittain: The study of aphids in Nova Scotia has been only a minor problem with us. Our results have been very much the same as those of Mr. Ross, with the exception of course, of the differences due to climate. You have about 13 or 14 generations of *pomi;* we never have more than 8 or 9. As for *avenæ*, I never saw it until this year, when it appeared in rather large numbers. This spring I could not find a specimen of *pomi*, and if we had not kept eggs over from last year we would not have had any at all to work with. Late in the summer, however, winged forms began to appear in numbers and soon the insect was quite numerous. *Malifoliæ*, with us, also has 8 or 9 generations per year. The greater number of the 3rd generation are migrants. A small proportion, under certain conditions, remain wingless and continue breeding on the apple throughout the season, but their number is usually negligible.

In 1915 a number of those which we kept in the insectary breeding upon the apple became winged in the 7th generation. These winged forms were the true spring migrants, though it was September.

In each generation we transferred some young aphids from the plantains back to apples, and vice versa. Hundreds of such experiments gave negative results; but in one case young from an ordinary wingless female of the 3rd generation on the apple, came to maturity on the plantain and became typical plantain forms.

In studying the natural control of these aphids we found that click beetles preyed upon them and sometimes destroyed large numbers.

Dr. Howard: What species?

Prof. Brittain: *Dalopius lateralis.*

Prof. Caesar: This comes right down to the matter that a number of us are so much interested in, that is the control. Mr. Ross spoke about the different dates of eggs hatching of the different species, and I should like to ask him whether all the eggs of all the important species are hatched by the time the buds have begun to burst.

MR. ROSS: Judging from our results in the orchard the vast majority of the eggs hatch before the buds burst. This year we sprayed as usual just before the buds burst and while they were still compact, and we destroyed practically 100 per cent. of the aphids. As we did not see any aphids on the sprayed trees afterwards it led me to think that all or practically all the eggs had hatched before the buds burst. In our insectary experiments, however, the eggs still continued to hatch after the buds burst.

PROF. BRITTAIN: I came across a very curious thing in British Columbia. I found a small number of aphids hatching when the snow was still on the ground in March, on days when the sun was hot. In Nova Scotia I have found them hatching outdoors until about the time the blossoms burst, though the vast majority of them, as Mr. Ross says, come out by the time the leaf buds burst.

MR. BIGGAR: Can you control the aphids in the greenhouse by spraying?

MR. ROSS: Yes, by using a nicotine extract, either by fumigating or by spraying.

PROF. CAESAR: Prof. Parrott has just come in and I believe is very much interested in work with aphids. I wonder if he has any information about the time of hatching of the eggs in relation to the different sprays.

PROF. PARROTT: One of my objects in coming to these meetings was to hear some of the papers given this afternoon, but I appear to have arrived too late to hear some of them. I am very much interested in the discussion of what I take to be the paper dealing with Apple Aphids. I agree with what was said by one speaker that by the time that the buds have broken and the leaves of the more advanced buds are out from 1/4 to 1/2 inch, the eggs of the three species, *pomi*, *sorbi* and *avenæ* have hatched. I make this statement with considerable assurance, because in two years' experience on one variety of apple we have been able to combat all three species, that is to eliminate the insects by drenching the trees.

Q.—What was that variety?

PROF. PARROTT: Rome Beauty. As a matter of fact one of the papers that I want to present at the Association of Economic Entomologists is one dealing with the control of the Rosy Aphis, as a problem for the extension entomologist. I believe we can get as clean-cut results in spraying for *sorbi*, *avenæ* and *pomi* as for almost any of the common insects on fruit trees. In our work we use several combinations of spraying materials, but the one we are recommending is composed of lime-sulphur solution, using the stock material at the rate of 1 to 7 or 1 to 8 of water, if scale insects are on the trees, and then to 100 gallons of the lime-sulphur we add 3/4 pint of nicotine sulphate. This is the spray we use on the Station grounds.

PROF. CAESAR: Your 100 gallons are equal to about 80 gallons of the measure which we use.

PROF. PARROTT: Yes, you use the imperial gallon measure. We have the San José Scale in nearly all the leading fruit growing sections of New York, and so we use the combination to combat the scale, apple scab and the rosy aphis. I don't know how the idea that one cannot rely on spraying at this time to combat the rosy aphis was so firmly established in the minds of some entomologists. I have been wondering if in breeding experiments by various workers, infested wood was in all cases obtained from identical situations. A miscellaneous assortment of infested wood, taken from trees subject to different conditions, might lead to wrong inferences as to the length of the incubation period. At Geneva, *Aphis avenæ* hatches first. As regards *pomi* and *sorbi* I don't think there is a great difference in time of hatching. I must admit that until this year we did not know the nymph of the first instar of *sorbi*, and the time of hatching was determined

by spraying at different dates. This year we were able to recognize the nymphs of the first instar of sorbi, and now that their identities are established we may safely say that most of the nymphs of the three species are out by the time that the leaves of the more advanced buds are projecting from one-fourth to half an inch.

Mr. Biggar: Which do you think would be more effective, concentrated or soluble sulphur?

Prof. Parrott: I am unable to advise you as to the wisdom of combining nicotine sulphate with soluble sulphur. You doubtless know that soluble sulphur depends for its insecticidal and fungicidal properties upon polysulphides and sulphides of sodium while lime-sulphur depends on sulphides of calcium. In New York we do not recommend a combination of arsenate of lead and soluble sulphur because soluble arsenic is formed. Soluble sulphur can be supplied by itself for the control of San José Scale or Leaf Blister Mite or for the control of Leaf Curl. We take a great deal of pains in our recommendations that fruit growers and farmers should clearly understand that they should not use sodium sulphide in combination with either arsenate of lead or other arsenicals.

Prof. Caesar: I have used calcium arsenate in combination with soluble sulphur and burned half the leaves off the trees. Is it not possible that your excellent results with the strong lime-sulphur (1 gallon to 8) and black leaf 40 on the aphids was due partly to the action of lime-sulphur on the eggs that were almost hatching?

Prof. Parrott: Yes, that is possible for a small percentage of the eggs; and has already been suggested by the manufacturers of nicotine sulphate. However, now that we are able to recognize the nymphs of the first instar, both Mr. Lathrop and myself were able this year, by observation, as by experimental operations, to show that as far as Rome apples were concerned, *sorbi* had all hatched by the time we began spraying. Now had you asked me in 1915, as I have previously stated, I could not have spoken so definitely on this point because we did not know the nymphs in their first instar.

Mr. Ross: This spring we obtained excellent results in the control of *A. malifoliæ*, *A. pomi*, and *A. avenæ* in a twelve acre orchard near Vineland, but later on our work was somewhat spoiled by *pomi* migrants which flew from neighbouring apple trees into the orchard and reinfested the trees.

Prof. Parrott: I may say in addition, that some of our associates in New York who have been somewhat reluctant to agree with us in some of our statements relative to *sorbi* are beginning to change their minds. After seeing the sprayed plants one could hardly draw conclusions very different from those I have presented. The problem for experimental workers now is to ascertain if it is profitable for the average grower to spray each spring in order to avoid losses by the rosy aphis.

Dr. Dearness: I should like to ask Mr. Ross whether that migration season seems to hold in the case of the Rosy Aphis. Did I understand you right that the generation that comes from the Plantago is oviparous, that there is a migration of viviparæ to the Plantago, and then that there is a generation of oviparous from that and whether that seems to be necessary?

Mr. Ross: The alatæ which migrate from the apple to the plantain are viviparous, and their progeny are viviparous. The return migrants from Plantago to apple are likewise viviparous, but their progeny—the sexual females—are oviparous.

Dr. Dearness: You think that the migration to the Plantain is necessary to that species?

Mr. Ross: I am not quite sure about that. We have been able to make *sorbi*

complete its cycle on the apple. I have some sexual females on the apple at the present time that we obtained from colonies that were on the apple all year. Of course I have been breeding the aphids under insectary conditions.

Dr. Dearness: Does it stimulate sexual development to be on the Plantago?

Mr. Ross: I do not know. The oviparous forms are given birth to by the migrants that fly back to the apple. In working with *avenæ* I was rather interested to find that I could not get that species to remain on apple even where I kept the specimens isolated, and I came to the conclusion that the migration instinct was much more strongly developed in this case than in the case of *malifoliæ*.

Prof. Brittain: The important point is that a number of our farmers will have to spray for this green apple bug. We do no spraying for this insect until just before the blossoms open. Is it going to be necessary to spray for *malifoliæ* and make two separate sprayings for the green apple bug? One of the orchards in which we were spraying for this latter pest had quite a severe outbreak of *sorbi*, but we omitted that first spray. We find that when we spray to control the green apple bug we have to give an extraordinarily thorough application, and we found that such an application gave us a fair commercial control of *malifoliæ* as well, though we did not destroy all of them, for the leaves curl right around them and provide a fine protection.

Q.—What spray gave you the best results against *malifoliæ?*

Prof. Brittain: At the time the small leaves were just about the size of a ten cent piece.

Mr. Ross: I should like to ask Prof. Parrott if he ever recommends that second spray when the blossoms are just showing pink for the aphids.

Prof. Parrott: I do not, Mr. Ross; but if you study the literature on spraying for apple aphides you will find all sorts of recommendations. If in New York we deferred treatment until that time, a great many of the stem-mothers would be missed by the application, on account of the curled leaves. I thoroughly endorse what was just said, that farmers as a rule do not spray thoroughly enough to control green apple bug. Certainly they do not control *malifoliæ* or *sorbi* for the same reason, and that is without doubt one of the problems now before us. We should encourage spraying practices that are calculated to hold the aphides in check.

Prof. Brittain: Spraying with nicotine is expensive. With us we frequently have to put on two applications, but if we had to put on three it would ruin us.

Prof. Parrott: I think in your case it would be worth experimenting to determine if you can delay the spray.

Prof. Brittain: In our work it is certain that we did not miss enough to pay us to put on a third application, but the work was done with great care.

Prof. Caesar: We have sometimes omitted the first application, and for San José Scale waited until just as the pink was showing, yet obtained good results on the scale without appreciable injury to the foliage.

Mr. Winn: Mr. Ross states that he has specimens of these aphides. I should like to know what method he takes of mounting or preserving such minute insects.

Mr. Ross: We use 70 per cent. alcohol for preserving aphides.

NOTE ON PHYSONOTA UNIPUNCTA (COLEOPTERA).

ALBERT F. WINN, WESTMOUNT, QUE.

In several parts of Mt. Royal Park, Montreal, there flourish large patches of a wild sunflower, *Helianthus decapetalus,* notably around the edges of the open area south and west of the toboggan slide, known as the "riding ring." This plant has long been known to local entomologists as the food of a species of Tortoise-beetle, and the early volumes of the *Canadian Entomologist** contain several articles by Caulfield and others relative to its habits and life-history.

Like most other insects, *Physonota unipuncta* has its years of abundance, and years when it seems to be wholly absent; but when common it is a most attractive beetle, resting quietly on the upper side of the leaves on a hot July day, its brilliant green and gold hues looking as if they belonged to a tropical insect. The ugly, soft, spiny larvæ with their forked tails recurved over the body and covered with remnants of cast off skins and excrement as is usual among the Cassidini; and the yellow and black pupæ—vaguely recalling in shape the horse-shoe crabs of the Atlantic coast—are also common on the plant.

By the end of August and early September, beetles again are seen on the leaves, but very different from the midsummer ones. There is not a trace of metallic green, but a sombre black and white, some examples mostly white, others with the black preponderating. Mr. Caulfield, who spent a good deal of time studying the beetle always used to refer to the summer and the autumn *broods* in just the same way that Lepidopterists speak of seasonally dimorphic butterflies and moths. On many occasions I have observed the beetles at rest and the larvæ at work, but as the adults, both green and black and white, have a most unfortunate habit of losing all their beauty and markings, becoming a uniform sickly yellow in cabinet specimens I have not paid much attention to the insect further than occasionally collecting a few larvæ along with other live stock to rear at home.

A few years ago, however, I was hunting around in the late fall for evidences of Lepidopterous boring larvæ in various plants, and this Helianthus came in for a little digging up by the roots, but very little injury was found. During the operations, among the earth upturned, a Physonota was noticed, and to my great surprise it was in its glorious green dress. No others were found, and although the matter seemed puzzling and contrary to what might be expected, a possible explanation was that occasional specimens of the early or summer brood went into hibernation.

Recently I had occasion to ask our good friend Mr. Morris, of Peterborough, whose papers on the relation of beetles to certain plants have been so interesting, whether Physonota was among his acquaintances. He replied that he had not found it, but would like to get some, so a look-out was kept for larvæ, and in July a box of larvæ and some leaves was sent. They reached him just before he was leaving for a vacation and he had a considerable amount of difficulty in finding an acceptable substitute for *Helianthus decapetalus*, and then had to find some one willing to look after the welfare of the repulsive looking grubs. He succeeded in doing both and reared some of the beetles.

Early in September I found that the sunflower had spread very much at the back of the western part of our Mountain, where it used to be rarely met with, and

*Caulfield, Can. Ent., xvi, 227 (1884); xviii, 41 (1886.)
Hamilton, Can. Ent. xvi, 134 (1884); xviii, 113 (1886.)

that beetles were in hundreds on the leaves as well as larvæ and pupæ, and a few were brought home. A week later the plants were again examined and among the many black and white beetles was one of a green color—not so brilliant as the July ones, but still decidedly green. Things were looking interesting now, so I hunted very carefully for nearly an hour and found two more green ones. These were boxed and brought home alive along with scores of the black and white ones. The following day when changing the food the green ones were looked for but instead of three there were *four* in the box. My first thought was that possibly one had been introduced into the box unnoticed beneath a leaf; but when they were taken out of the box it was seen that while all were green, they were not all of the same brilliancy. The four were then placed in a separate box from the black and white ones to see what would happen next. Next day showed clearly what was going on: the black and white ones were all slowly but surely assuming the green color, the lower edges of elytre becoming green first and gradually spreading to the suture, the black becoming an olive green and the white yellowish. As the green brightens the yellow spots disappear and in a couple of days they are so altered that one could hardly believe it possible unless the change was actually seen going on.

I can recall no reference to such a change of color in an apparently mature insect, and would like to know what explanation can be given of the changes that go on and will gladly try to furnish living material next year to anyone wishing to investigate. The unearthing of the green one in the fall was now explained, but I took the first opportunity of revisiting a Helianthus patch and poked around a little amongst the dead leaves and surface soil. Sure enough, the beetles found on and below the ground were all green, while the black and white ones were plantiful on the leaves and flowers.

Among the hundreds of beetles observed on the plants during September and the many kept alive at home there was no apparent disposition to mate, and it seems certain that this does not occur till they emerge from winter quarters. It also seems that instead of two annual broods we have but one in Montreal; the glorious green beetles of midsummer are the transmuted black and white ones that quitted the plants and entered the ground in the previous September. Like other hibernating imagoes the time of appearance differs in individuals, and mating and egg laying are spread over an extended period, hence the finding of the insects simultaneously in all stages on the plants. It is, of course, possible that a partial second brood occurs under favorable conditions, and this could easily be found out by breeding from the egg. The larvæ are not at all difficult to rear if one has a supply of fresh Helianthus leaves at hand. I have never seen the insects except on Helianthus in the fields, but see that Blatchley* states that "it occurs on flowers of Crataegus; on the horse-mint (Monarda) and on resin-weed—both larvæ and adults feeding on the latter." It is interesting to note that he refers to the color of imago as pale greenish-yellow.

*Coleoptera of Indiana, p. 1229.

PRELIMINARY NOTES ON THE USE OF REPELLENTS FOR HORN FLIES AND STABLE FLIES ON CATTLE.

A. W. Baker, Ontario Agricultural College, Guelph.

The following notes are on the results of work done during the summer of 1914. The summer of 1915 was so excessively wet that satisfactory spraying experiments on cattle could not be carried on, and it was found impossible, due to stress of other work, to continue these experiments during the summer of 1916. Since the results obtained, however, may be of interest to some, it was thought advisable to give these preliminary notes at this time.

Cattle Used in the Tests.

The tests of repellents were conducted on part of the beef herd of the Ontario Agricultural College. Fifteen milch cows and seven yearlings were used. On certain of these the same repellent was used continuously, and some also were retained as checks throughout all the tests. All repellents, however, were given a test on cattle of various types and colors, and cattle of various types and colors were also used as checks. It was found that the repellent action of all the sprays was practically lost in a week or ten days, so some cattle were used as checks which were used for spray tests earlier or later in the work. This shifting of sprays and checks made it more possible to get thorough results in all tests. The tests were continued without interruption, save on rainy days, throughout the months of July and August. The cattle were sprayed immediately following the morning milking. Notes were made in the pasture in the middle of the afternoon, and in the stable in the morning before spraying.

The writer was assisted in the work by Messrs. A. R. Burrows and R. S. Hartley, student-assistants in the Department of Entomology of the Ontario Agricultural College.

Object of the Work.

This work was undertaken with a view to securing if possible a fly repellent which could be prepared cheaply by the farmer, which would give repellent action for at least two days if possible, and which at the same time would not taint the milk, blister the animal or make the coat unsightly.

Repellents Used.

Four commercial fly repellents were tested and ten home-made repellents. Of the latter, three were repellents which had previously been recommended by various workers, and the remainder were mixtures which were devised by the writer.

The following is a list of the various repellents used, with the formulæ for preparation, and a very brief summary of the results secured.

Commercial Repellents.

The commercial fly repellents used were La Lo, Williams and Coopers. All three gave good repellent action, but this was not so long continued in the case of Williams and Coopers as with La Lo. Where cattle were thoroughly sprayed it was found that the cost of all commercial repellents used was excessive. Some blistering was noted on three animals sprayed with La Lo, and some very slight blistering on one sprayed with Williams.

Black Leaf 40 was also tested as a repellent. This was used in the proportion of one part to 666 parts of water, both with and without oil of citronella. Fair repellent action was secured in the latter case, but this was evidenced for such a very short time that the mixture could not be considered of any practical value as a fly repellent.

HOME-MADE REPELLENTS.

I. Kerosene Emulsion:

½ lb. yellow soap.
1 gal. soft water. } After preparation, add 1 gal. water.
2 gals. kerosene.

This was used in proportions of 1 to 5 and 1 to 3 of water, both with and without oil of citronella. At no strength used was repellent action secured, which was sufficient to enable us to consider it of any value for practical use.

II. Flour Emulsion:

6 oz. flour.
1 qt. kerosene.
2 gals. water.

As with Kerosene Emulsion, the repellent action secured with this mixture was so slight and of such short duration as to be of no practical value.

III. Milk Emulsion:

Slightly sour milk, one part.
Kerosene, two parts.

This stock solution was used in proportion of 1 to 15, 1 to 12, and 1 to 8, of water, both with and without oil of citronella. When used in the proportion of 1 to 8, with oil of citronella, very fair repellant action was secured, which was quite plainly evident on the day following the spraying. This suggested to us that the milk emulsion could be used as a medium for the application of some substance with a stronger repellent action. The milk emulsion we found could not be used as a practical repellent in itself, because of the large quantities which it was found necessary to apply to each animal.

IV. Milk Emulsion and Olive Oil:

1 part slightly sour milk.
1 part kerosene.
1 part olive oil.

This stock solution used 1 to 8 parts of water. The repellent action secured was comparatively slight and in any case the introduction of olive oil made the spray so costly that it could not be considered of practical value, even though much smaller quantities could be used than was the case with milk emulsion itself.

V. Milk Emulsion and Linseed Oil:

Stock Solution No. 1.

2 parts slightly sour milk.
2 parts linseed oil.
3 parts kerosene.

Used in proportions of 1 to 8, 1 to 4, 1 to 2, both with and without oil of citronella. Even in the proportion of 1 to 2 with the addition of oil of citronella, the repellent action secured was only fair, and the cost was such that the mixture could not be considered of practical value.

Stock Emulsion No. 2.

1 part slightly sour milk.
1 part linseed oil.
3 parts kerosene.

This stock solution was also used in the proportions of 1 to 8, 1 to 4, and 1 to 2, both with and without oil of citronella. As with the first stock solution the repellent action was such that considering the cost the mixture could not be looked on as of practical value.

VI. Milk Emulsion, Olive Oil and Linseed Oil:

1 part slightly sour milk.
1 part olive oil.
1 part linseed oil.
3 parts kerosene.

Used in the proportions of 1 to 8, 1 to 4, and 1 to 2, both with and without oil of citronella.

The repellent action secured by this mixture was only fair, even when used in the proportion of 1 to 2, with oil of citronella, and the cost was such that the mixture could not be considered of practical value.

VII. Milk Emulsion and Fish Oil:

Mixture No. 1.

2 parts milk emulsion, stock solution.
1 part fish oil.
4 parts water.

When used with oil of citronella the repellent action secured was good, and it was found necessary to apply only small quantities of the mixture.

Mixture No. 2.

1 part milk emulsion, stock solution.
1 part fish oil.
4 parts water.

When used with oil of citronella good repellent action was secured, and it was found necessary to apply only small quantities of this mixture.

The success of the milk emulsion as a repellent when fish oil was added to it led us to believe that if we incorporated fish oil in the stock solution and then diluted this with water in the necessary proportions, that we should have a rather satisfactory repellent. This led us to compound the following mixture.

VIII. Fish Oil, Kerosene and Milk.

1 gal. fish oil.
1 gal. Kerosene.
1 gal. slightly sour milk.
6 oz. oil of citronella.

This stock solution was used in proportions of 1 to 2, 1 to 3 and 1 to 4, of water. The repellent action secured in all cases was good, so much so that the mixture can be recommended as having decided practical value.

This mixture gave far the best results of any home-made mixtures tested, and the amount required is so small that the cost of spraying is extremely slight as compared with that of commercial repellents.

Another summer's work will doubtless improve the stock solution, in that the proportion of the ingredients may be varied somewhat, but the writer feels that the mixture essentially as given will form the basis for a very satisfactory home-made repellent.

Since the work outlined here was undertaken this mixture has been recommended for trial to a considerable number of farmers, and in all cases where reports have been received from them, the mixture has given very good results as a repellent.

It was found necessary when this spray was first started to apply it every day

to secure good results. The writer feels sure, however, that if spraying was continued throughout the whole season with the one mixture that the time of spraying could be reduced to once in every two days, or even once in every three days. In the same way probably the strength of the spray could be reduced after using for some time.

Amount of Spray Used.

When used in the proportion of 1 to 2, one imperial quart was sufficient for eleven cows, that is one gallon as applied at 1 to 2 was sufficient for 44 cows. At 1 to 4, one gallon as applied was sufficient for 32 cows. It should be borne in mind that in spraying each cow was absolutely covered from horns to hoofs with the mixture, not simply a band along the back and sides, as is so often done.

It was found that better results could be secured in spraying the cattle by using a cheap hand-atomizer sprayer than by using a knapsack-sprayer.

Working with these hand sprayers two men in ten minutes could thoroughly spray 13 cows, averaging about one and two-third minutes per cow.

The Cost of Spraying.

The following cost summary is based of course on pre-war prices:

Fish oil, 1 gal.	$0 80
Kerosene, 1 gal.	20
Milk, 1 gal.	20
Oil of citronella, 6 oz.	60
	$1 80

i.e., $1.80 for 3 gallons of stock solution.

In the proportion of 1 to 2, the cost as applied was 20 cts. per gallon.

In the proportion of 1 to 4, the cost as applied was 12 cts. per gallon.

The cost then of spraying thoroughly with this mixture at 1 to 2 is 5 11 cts. per cow. The cost of spraying at 1 to 4 is 3/8 cts. per cow.

As mentioned above the writer found this mixture by far the most satisfactory of all the home-made repellents tested, but he would like it borne in mind that it is the result of only one season's work, and although he is satisfied that it will form the basis of a very satisfactory repellent, he feels that the proportions used can probably be improved in another season's work, and so does not recommend this mixture as finally satisfactory.

Prof. Parrott: Was any work done while you were carrying on this experiment with the repellents to determine the effect of the treatments on the yields of milk or butter?

Mr. Baker: None. I hope before I put it in final form to do this work: to run check animals exposed to all the attacks of flies outside, and to treat others with a series of sprays of different proportions, and then keep a record of milk returns in both lots. So far as I know there has been only one record of systematic work done along this line.

Prof. Parrott: Nineteen years ago I was given the problem of determining the most efficient materials for protecting animals from flies, and the conclusions you have drawn are in the main quite similar to the results I obtained. It was not very hard to decoct a preparation as efficient as some of the repellents on the market. I found also that both commercial and home-made mixtures gave only temporary relief, and there was always the question of whether or not the applications had any effect on the yields of milk or butter. When at the Ohio Experi-

ment Station I was actually confronted with data obtained by another department showing that applications of commercial and home-made insecticides did not give any protection at all as measured by milk yields. I considered the data inconclusive, and I do believe that a careful experiment would show that flies do diminish production. If so, data along this line would encourage farmers to give their animals proper care.

Mr. Baker: There is no doubt that it gives increased beef production.

Prof. Parrott: I am of the impression that it is possible to divide a dairy herd so as to get conclusive data. Such an experiment would certainly be worth while.

Dr. Hewitt: The experiences in the Texas Fever Tick uphold that idea, if only you can convince the farmers of the advanced milk production so that they will undertake measures of control.

Mr. Baker: The primary reason this work was undertaken here was because of the fact that every summer we have numerous requests from farmers for a satisfactory fly repellent, and they seem to be unanimous in the statement that the milk production of the cattle is seriously injured. I can call to mind probably half a dozen communications last year definitely stating that the cattle had gone back on the milk flow where the flies were extremely bad.

Prof. Parrott: If a dairy expert would co-operate with a entomologist on the problem, one ought to get very valuable data, because fly attacks must cause great discomfort to cattle, and thus reduce the yields of milk.

Dr. Howard: I should like to ask Mr. Baker if oil of citronella can be purchased in this country for ten cents an ounce now. We have been trying to buy oil of citronella this past summer, and after the apothecaries had sold out their previous stock it was impossible for them to obtain any more. The situation was worse than the price being prohibitive, for we could not get it at all.

Mr. Baker: The prices I have quoted were those prevailing before the war. Until the druggists ran out of oil of citronella, we could get it at a price considerably increased, but since then we have tried and were not able to get it in the city of Guelph.

Mr. Criddle: I have seen a good deal of the cattle business in Western Canada. There is a very marked decrease in the milk production during the fly season. For that simple reason very many cattlemen keep their cattle until after the fly season is over so that they can fatten them up again.

EVENING MEETING.

On Thursday evening the auditorium of Massey Hall was filled with students of the College and the Macdonald Institute, in addition to the members and visitors from the town of Guelph, who came together to hear a lecture on "The Relation of Insects to Disease in Man and Animals," by Dr. L. O. Howard, Chief of the U. S. Bureau of Entomology at Washington. A large number of lantern slides were exhibited, which added greatly to the interest, and rendered more intelligible to the student body the more technical positions of the address.

In the absence of President Creelman, the Society was welcomed to the College by Prof. Zavitz, and at the close of the meeting a vote of thanks, proposed by Dr. Hewitt, and seconded by Prof. Lochhead, was tendered to Dr. Howard for his instructive and highly interesting address.

THE RELATION OF INSECTS TO DISEASE IN MAN AND ANIMALS.

Dr. L. O. Howard, Washington, D.C.

There are many here to-night to whom much that I shall say will be an old story. In fact, more than sixteen years ago, in a lecture which I gave before the Royal Society of Canada, May 30th, 1900, I showed some of the same lantern slides, which I shall show to-night, and even then the interest in the subject was very keen and was still keener when three and one-half years later I spoke before the Entomological Society of Ontario, at its September, 1903, meeting at Ottawa, on the transmission of yellow fever by mosquitoes. That time my lantern slides were held up at the border, and I am able to-night to show them for the first time to the members of this Society.

After all, what is a period of sixteen years in the history of medicine and of medical discoveries? The whole great field has practically developed within the last twenty years. Take some standard medical work of twenty years ago, such as the 1896 editions of Osler's "Theory and Practice of Medicine," and you will find absolutely no mention of insects as connected with the etiology of disease either of man or of the higher animals.

And yet the foundations were already laid. In 1889 Theobald Smith, eight years out of Cornell, and six years out of the Albany Medical College, and already farther advanced as an investigator than any of his teachers, discovered the causative organism of the so-called Texas fever of cattle, in the shape of a minute pear-shaped protozoan in the red blood corpuscles, to which was given the name *Pyrosoma bigeminum* (now known as *Babesia bovis*). With the experimental aid of F. L. Kilbourne, a doctor of veterinary medicine and engaged, as was Dr. Smith, in research work under the Bureau of Animal Industry of the United States Department of Agriculture at Washington, he showed that this organism is carried from southern cattle to non-immune cattle by the so-called southern cattle tick (*Margaropus annulatus*). The results of this experimental work were published in 1893.

Even before this, Dr. Patrick Manson, now Sir Patrick Manson, demonstrated the carriage of the parasitic worm, *Filaria nocturna*, responsible for certain of the diseases grouped under the name filariasis, from mosquitoes to man.

This, however, was by no means as significant as the discovery of Theobald Smith, and undoubtedly attention would have been directed at an earlier date to the possible transfer by insects of diseases caused by blood-inhabiting micro-organisms with man, had the revolutionary paper by Smith and Kilbourne attracted more general attention. But it came from a veterinary service, and was published in the Annual Report of the United States Department of Agriculture, a publication which at that time unfortunately received but little attention from the scientific world in general.

So it was not until 1897 that Ross, at the suggestion of Manson, began out in India his work on the possible carriage of malaria by certain mosquitoes, an investigation which resulted triumphantly in 1898, and which ranks as one of the monumental discoveries in medical science.

Ross's work was immediately corroborated by Italian workers, and intensive investigations of the blood-inhabiting protozoa were immediately begun. In a very short time sound proof of the carriage of yellow fever by *Aedes calopus* was brought forward by Walter Reed and his co-workers, Carroll, Lazear and Agramonte, and research in this direction was taken up all over the world. Constantly increasing in

volume, discovery after discovery has been made, until at the present time, practically only a score of years after its inception, the literature on this subject has become enormous, the workers in the field constitute an army, comprehensive volumes on medical entomology have been published (two in the United States within the past year), advanced students are taking up the subject as their life work, and as the months go by the field opens further and further until it is evident that its importance especially regarding the etiology of tropical disease, can scarcely be exaggerated.

So numerous have the discoveries become of late that it would take a course of lectures to display the results, and I must confine myself to-night to comparatively few, easily illustrated aspects.

It is convenient, and in fact necessary, to divide the field in any discussion into three categories:

First, insects as simple carriers of disease, the accidental carriers as it were; that is, insects frequenting places where disease germs are likely to occur, and conveying these in their stomachs or on their bodies to food supplies. This class is notably illustrated by the house fly.

Second, insects as direct inoculators of disease. These are biting insects which feed upon diseased men or animals, and carry the causative organisms on their beaks and insert them into the circulation of healthy individuals. In this way anthrax is carried by biting flies; surra is carried the same way, as is also the *nagana* or tsetse-fly disease of cattle. So also is bubonic plague carried in this manner by rat fleas, but here there is more than a passive carriage, as is also the case with the tsetse-fly disease.

The third category, and this is perhaps the most important, insects as essential hosts of pathogenic organisms. These are the cases in which the parasitic organism undergoes its sexual generation in the body of its insect host and another, non-sexual, generation or generations in its warm-blooded host. To this class belong the malarial mosquitoes, the yellow fever mosquito, and the rapidly increasing number of species that carry Trypanosomiases, Leishmaniases, Spirochætoses, and the ticks that carry relapsing fevers and other fevers of man and animals, and the lice that carry typhus fever.

Insects as Simple Carriers of Disease.

The House-Fly. (Lantern slides and general discussion).

Cockroaches, ants and other insects. It is perfectly possible, as above stated, that any insect which comes in contact with, either accidently or for feeding purposes, excremental or other material containing pathogenic organisms and then passes to the food or bodies of men and animals may thus become a simple carrier of disease. There are plenty of obvious illustrations of this. Darling, in the Canal Zone, has shown that ants which flourish in the tropics may thus carry disease, and in fact the little house ants in temperate regions may also function in this way. The same thing may be said of cockroaches, and especially of the small so-called German cockroach, which multiplies excessively in unclean establishments, and it may also be said of the latrine fly (*Fannia scalaris*) which breeds in latrines and which has frequent access to food, although not so greatly attracted to food supplies as is the true house-fly. And there are numbers of other insects which may from time to time play this part, although, speaking of flies, I pointed out many years ago that over 97 per cent. of the flies found all over the country in dining-rooms and kitchens, are true house-flies.

Insects as Direct Inoculators of Disease.

This is another simple relation, and the insects which carry disease in this way are piercing species, taking up germs and inserting their contaminated mouth parts into their healthy victim. This transfer is precisely analogous to blood-poisoning from the prick of a contaminated needle or pin. A little earlier this method of carriage of disease was considered to be more easily possible than it is at present. A study of the habits of many of these blood-sucking insects indicates that, while they take a very full meal, they frequently wait for many hours before attempting another bite, and in the meantime ingested bacteria may be digested or excreted and the beak become cleansed or the micro-organisms dried up.

Nevertheless this method still holds, and it is in this way that certain biting flies carry the disease known as anthrax or malignant pustule, and in the same way the very destructive disease of domestic animals in oriental regions, known as surra, is carried by gadflies. In this same way also the disease of cattle in Africa long known as fly sickness or nagana is carried by one or more of the tsetse flies of the genus Glossina. Although, while it is possible for this disease to be almost immediately inoculated after the first bite of a diseased cow, by simple transfer, the fact that after a term of days has elapsed inoculation again becomes possible indicates that the parasitic organism may undergo a sexual development in the body of the fly. This will be brought out later in speaking of sleeping sickness.

In the case of the rat fleas and bubonic plague, about which so much has been written of late years, there occurs also something more than a passive carriage, although the causative organism of bubonic plague is one of the bacteria, and is known as *Bacillus pestis*. The story of the discovery of the carriage of this dread disease by fleas is a most interesting one, but cannot be told at length. Any flea which attacks both rodents and man may be an agent in the transmission of the disease, and several species are thus implicated. Inasmuch as the causative organism of the disease is a Bacillus, and is not dependent upon any insect for the completion of its development, theoretically any blood-sucking insect which feeds upon a plague-infected man or animal, and then passes to a healthy individual may carry the disease. Thus bacilli have been found in a head-louse taken from an infected man, and in a louse taken from an infected squirrel.

Moreover, it has been found that in bubonic plague the disease may be spread from man to man without any intermediary whatever. Conclusive evidence to this effect was found by Dr. Strong and Dr. Teague during the Manchurian epidemic of 1910-11. This type of the disease, however, forms a very small percentage of the human cases, and in the great majority of cases of a plague epidemic fleas are the responsible carriers, and as a rule rats or other rodents, such as the ground-squirrels of California, form the other end of the chain. So practically all the measures in the modern cities are based upon the destruction of rats, and we in the United States recall with pride the campaign against the rats and the plague carried on so successfully only a few years ago in San Francisco, under the direction of the present Surgeon-General of our Public Health Service, Dr. Rupert Blue.

While feeding, fleas are in the habit of squirting blood from the anus, and where they have been feeding upon mice and rats dying of plague, this excreted blood is found to be full of the plague bacilli. Thus, not only may the disease be caused by the bite, but by subsequent scratching. Moreover, Bacot and Martin have shown very recently that plague-infected fleas regurgitate blood through the mouth, and that the disease may be thus transmitted.

Insects as Essential Hosts of Pathogenic Organisms.

Beyond the mere statement that a number of tapeworms undergo their sexual stage in some insect or other Arthropod, and that of these at least two are occasional parasites of man, while others commonly affect domestic animals, it may be well to point out that one of these species, *Hymenolepis diminuta*, living commonly in the intestines of rats and mice, has as its alternate host certain insects which feed in meal, and that man may become infected by eating the dejecta of such insects in dirty cereals.

It should also be stated in passing that several nematode worms have this dual relation. Sir Patrick Manson's discovery of the carriage of *Filaria nocturna* by *Culex fatigans*, thus producing filariasis, is exemplified most terribly by certain forms of elephantiasis. Further, recently Dr. Ransom, of Washington, has shown that a common nematode parasite of the house fly, known as *Habronema muscæ*, is, in another stage, a stomach parasite of the horse, and that the embryos produced by the parent worms in the stomach of the horse pass out with the fæces and enter the bodies of fly larvæ, which are developing in the manure. Infested flies, dead or alive, are accidently swallowed by horses, and the parasite completes its development to maturity in the stomach of this definitive host.

There is still another nematode which may be mentioned on account of the fact that it brings in an entirely new type of insect host, namely *Echinorhynchus gigas*, a common parasite of the pig, and reported as occurring in man. In Europe the usual intermediate hosts are the larvæ of the cockchafer, and in the United States the common white grub or larva of the so-called June-bug.

Mosquitoes and malaria. (Discussion and lantern slides).

Mosquitoes and yellow fever. (Discussion and lantern slides).

Insects and trypanosomyiasis. The curious, flagellate protozoa known as Trypanosomes are coming more and more to the front as causative organisms of various diseases, especially in the tropics. It is one of these organisms which causes the nagana of African cattle, and is carried by the tsetse fly known as *Glossina morsitans*. As noted above, this insect is not only a direct inoculator of the disease, but is an essential host of the parasite. Sir David Bruce, of England, discovered the causative organism, and established the fact of its transfer by tsetse flies, but it was a German observer, Kleine, who demonstrated in 1909, that a part of the life cycle of the parasite takes place in the fly, which becomes infective again after ten days, and able to transmit the disease for weeks thereafter.

Another trypanosome disease which has become famous is the one which causes the sleeping sickness of Africa, and of this disease the tsetse fly *Glossina palpalis* is the necessary secondary host. This disease is said to have caused thirty thousand deaths between 1902 and 1905, in the British Province Bugosa on the Victoria Nyanza.

Down in Brazil it has been quite recently discovered that a disease known as Opilaçao, a wasting disease of children, is caused by *Trypanosoma cruzi*, and that the definitive host of this organism is one of the large biting true bugs known as *Conorhinus megistus*, a close relative to the so-called giant bedbug of this country, *Conorhinus sanguisuga*. This discovery by Chagas, of the Oswaldo Cruz Institute, was considered so important that another learned member of the Institute, Arturo Neiva, visited the United States and Europe just before the war, in order to monograph competently the biting bugs of this group.

Insects and Leishmanioses. The Leishmania organisms are intracellular

parasites allied to the trypanosomes. These parasites are responsible for a number of tropical diseases, especially the one known as *kala azar* of human beings, and here the evolutive cycle is claimed by Patton to take place in the common bedbug, but this, however, is not generally accepted.

Ticks and Spirochætosis. The spirochætes are probably protozoa. Spirochætosis is also referred to in the literature as Spiroplasmosis and Babesiosis. These organisms are responsible for several serious diseases of animals and two of man. The organism of Texas fever of cattle, referred to in our opening remarks, and which is carried by the cattle tick, is an example. The sexual reproduction of this organism in the blood of cattle is well known, but the sexual reproduction in the tick has not yet been made out, although in a related species, *Babesia canis,* of the dog, causing maligant jaundice in Africa and parts of southern Europe, this cycle has been worked out by Christopher.

The life cycle of a spirochæte has been especially worked out in the disease known as spirochætosis of fowls, which occurs in southeastern Europe, Asia, Africa, South America and Australia. This disease is transmitted from fowl to fowl by a tick known as *Argas persicus.* The full life cycle has been worked out especially well by Balfour and Hindle, and is diagrammatically represented on the accompanying slide.

Ticks and Rocky Mountain Spotted Fever. This is the first of the probable spirochæte diseases of man carried by ticks. (Discussion and lantern slides).

The other human disease referred to is the European relapsing fever, which at first was supposed to be carried by bedbugs, but which has since been shown to be carried by lice.

This brings us to *Typhus fever and lice.* (Discussion and lantern slides).

But now we must stop. There are many subjects in the field which we have not touched. Tick paralysis, for example, is a most interesting and novel subject. This disease occurs in Australia, Africa and North America. In Oregon thirteen cases have been found in the practice of a single physician. The attachment of a tick brings about progressive paralysis involving motor, but not sensory nerves. It seems a unique malady. Hadwen and Nuttall, showing that it is not infectious and that there is apparently an incubating period in the tick, suggest a specific causative organism, but others hold to the theory of nerve shock.

Attention should also be called to the fact that, in spite of the host of discoveries already well established, there is a danger in our tendency to exaggerate the importance of insect transmission, and to overlook, even in cases where insects may occasionally be concerned, the greater importance of other modes of infection. This is indicated by Sambon's theory of transmission of pellagra by Simulium—a theory which was advanced with enthusiasm on the ground that it fitted into the known facts in the epidemiology of the disease. It took two years of hard work on the part of members of the force of the Bureau of Entomology, working in collaboration with the Thompson-McFadden Pellagra Commission, to upset this theory in a thoroughly scientific manner. As has been pointed out several times of late, there is always considerable danger in conclusions based on epidemiological findings. Transmisson experiments are necessary.

One conclusion must be drawn which can hardly be disputed: There is an enormous field for the entomologist in the careful study of all of the aspects of the biology, of not only those insects which have already been shown to be disease carriers, but of those which are likely to be implicated. It is to the trained economic entomologist that we must look for the methods of destruction of those

insect carriers, and the prevention of this class of diseases lies at his door, rather than at that of the physician. Either that, or sanitarians must be trained in what is now known as medical entomology.

SECOND DAY'S SESSION—FRIDAY, NOV. 3RD.

THE WOOD OF DESIRE.

FRANCIS J. A. MORRIS, PETERBOROUGH.

In September, 1913, about a week after my arrival in Peterborough, I found myself toiling, one hot afternoon, up a steep hill-side just east of the city. All the explorer's romantic sense of adventure thrilled me, for these were pioneer days in a new district, and I was very curious to know what lay beyond the hill, what sort of view would unroll before me from the little knot of pines that topped the height. Up and up I struggled, like stout Cortez, till at last I won to the coveted vantage-ground, and found myself staring out over a wide and varied strath that rolled ocean-like between the Otonabee and Indian River.

In the foreground, to the south, lay Burnham's wood, brimful as a magician's box with insect marvels I was to conjure forth next season. And east of there, after a mile or more of open country, the timber lands began again: at first just scattered farm lots of elm and maple, but, from a point in the middle distance, not far south of the C.P.R. there stretched across the background a wood far larger and denser than any of these: widening as it went, it spread to the south-east verge of sky in the form of an enormous fan. In view of its distance, this must, if continuous, be a veritable forest, and field glasses trained upon it revealed no break in all its surface; it stood the test—a solid fan of timber, ribbed with hemlock and spruce, fringed with pine, the framework compact of beech and maple.

Though I found enough to engross my attention next season, in the forefront of this woodland paradise, yet always in imagination loomed up that mysterious background; and when, in May of last year, I drew the covers of Burnham's wood repeatedly without a single view-halloo of novel game, elfin fingers from the far horizon, beckoning fast and furiously, would no longer be denied. So in the first week of June, with a fardel as varied as that of Autolycus, I set out across country for this wood of my desire and merrily hent the stile, as light-hearted and innocent a snapper up of unconsidered trifles as any son of Hermes in the land.

Like every fastness worthy the name, it had its approaches well guarded: for a mile or more along its northern frontier I probed vainly for a point of penetration; thickets of prickly ash, a broad belt of willow and alder, a meandering stream of uncertain channel, all combined to form a zariba moated and impervious. At last, by the north-east corner of the wood, the swamps drew to a narrow neck, and along an old winter road strewn with elm logs I stole my first entrance—the planet in the ascendant doubtless Mercury, lucky star of all pedlars and the light-fingered gentry.

No sooner had I crossed the threshold and won to the heart as it were of this dark tower of romance than I became the butt—the more than willing target—for a perfect bombardment of new discoveries. On one of the elm logs that had served me for drawbridge in the passage of the moat, I caught a gleam of steely blue about the corrugated bark. It was *Physocnemum brevilineum*, and I soon

found this interesting longicorn settling in considerable numbers on the logs. It had evidently lately emerged from its bores in the elms. I captured several pairs hidden under flakes of the bark, and about a dozen running along the logs after flight in the sunshine. Only once before had I taken this creature and that had been on the trunk of a standing elm, green and flourishing. It was, therefore, of interest to note that these logs were dead, and had been lying—some of them—for three or four seasons.

The excitement of this first find was hardly spent before I spied a newly emerged specimen of *Saperda tridentata*, slowly waving its antennæ and preening itself in the ecstasy of a first sun bath. The elm saperda is no doubt a common insect, and on summer evenings I have occasionally taken a stray specimen, attracted to light through an open window; but I had never before happened on its chosen breeding grounds. *Larvæ* and *pupæ* were frequent in the inner bark of several logs and stumps, and while it seemed emerging most abundantly in the first ten days of June (exactly the season of the basswood saperda), occasional specimens were taken throughout the month. This first day's bag tallied 17.

The winter road turned sharply west at the neck of the swamp, leading past a couple of woodpiles and a heap of brush. Here I captured (besides 3 more elm borers) 2 basswood borers, a fine specimen of *Callidium antennatum*, and (on a billet of white pine) a strange beetle that looked like a small *Criocephalus* or a light-colored, long and narrow specimen of *Asemum moestum*; it proved to be *Tetropium cinnamopterum*; evidently a rarity, for I have only seen one other; that was last July in the Algonquin Park, taken resting in shadow on the under-side of a newly fallen white spruce.

In the middle of June I returned to the scene and right in the same tract captured on a basswood log *Pogonocharuss mixtus*, and my third specimen of *Hoplosia nubila*. The season of 1915, however, proved far from ideal for sun-worshippers, cold east winds more than countervailing the bright sunshine. It was on this second trip that I noted, at the north edge of the wood, some large bushes of thimbleberry crowded with sprays of bud that promised well. While following the winter road south through the heart of the wood I came across several patches of the rare striped coral-root in full bloom. Then, after crossing a couple of hardwood ridges, I descended to a rich piece of tamarac swamp, and groping my way through a dense mist of mosquitoes, along a track of sphagnum moss and decaying corduroy emerged at last on a gravel road intersecting the wood from west to east. Despite bloodsuckers and bogholes I was not empty-handed when I reached *terra firma*. From willow foliage I had gathered half a dozen specimens of *Lina scripta*, on a hemlock stump *Rhagium lineatum*, and in blossoms of buttercup and fleabane several specimens of *Anthaxia æneogaster* and *Leptura vibex*.

To the making and through the heart of as pretty a piece of landscape as you might find in all the Province went this gravel road; wooded on both sides and flanked on the north by a fringe of heaths—Labrador tea, andromeda and American laurel—all in bloom; on the south by a shallow ditch filled with marsh fern. To the west, at a bend in the road, the ditch was backed by a low escarpment of shaded bank, based with clumps of crested and prickly shield fern and occasional masses of giant osmunda; the whole forming a kind of natural ha-ha, behind which spread, well above swamp level, a hardwood of maple and beech. Due south at somewhat greater distance the woods climbed suddenly out of the swamp and rose rapidly to the sky-line, presenting to the enraptured eye tier above tier of balsam and silver birch, elm and maple, in the varied shades of lush soft green that mark

the leafy month of June. South-east alone, bounded on three sides by woods, you caught a glimpse of open meadow, a tiny wedge driven into the forest by the hand of man.

In the swamps of old Ontario, though the whole Dominion go dry, you may still drink deep of this wine of life, till you fairly reel with the beauty of it all. Over the road dragonflies hover and dart; butterflies flutter in varied hue, little Blues and Coppers and Hairstreaks; once in a while a great Fritillary or a Swallow-tail comes sailing along; far up in the vault of sky a pair of hawks wheel and poise, their faint keening, from that giddy height, falls feebly on the ear. From the depths of the swamp come at intervals the gentle croon of the Mourning Dove, the sweet, long-drawn whistle of the Whitethroat; presently, drowning all else, from some hidden turret in a Balm of Gilead showers down a flood of delicious music, sweeter than the carol of a robin, perhaps the notes of that master-singer, the Rose-breasted Grosbeak. Who could be blind and deaf to all this? Not even an entomologist in the last stage of "cerambyciditis." Mosquitoes and deer-fly are soon forgotten; indeed, when taken in bulk, as it were, they are much less of a nuisance than retailed in ones and twos; I had far rather move imperturbably through an open swamp, the pincushion for a thousand, than sit on a verandah and smash desperately at half a dozen, or crouch abjectly under canvas listening to the shrill slogan of one. In the open they are mere pin pricks and we can cry with happy-go-lucky Launcelot Gobbo—"Here are simple scapes! If fortune be a woman, she's a good wench for this gear."

Refreshed as by a draught of spring water I plunged once more into the swamp, following a woodman's path to the south of the gravel road. A little way in, the path bore to the right and at length debouched on a dry upland pasture west of the wood. Beside the path were a number of straggling shrubs of spiked maple, and the bloom was not quite over. In just such surroundings near Port Hope I had taken on these blossoms not a few beetles of interest and one or two of considerable rarity. Above all, a unique specimen of a small *Anaglyptus*, which had been declared in Montreal the male of *Microclytus gazellula*. Spiked maple, too, is the favorite haunt of *Corymbites hamatus*, a very prettily marked click-beetle. It was too late, however, and all I could find were a few specimens of *Leptura capitata* and *Callimoxys sanguinicollis*. But I marked the place in my mind for an early visit in 1916, and made my way home by the newly found gravel road, a forced and zig-zag course, uphill and downdale, along the claw of my spreading fan of woodland, past Burnham's, to the Lift Locks and the City.

In the fourth week of June I made my third visit to the Wood of Desire, holding to the gravel road till almost the end of the journey, when I skirted a fence due north to where the thimbleberry bushes grew. They were a snowy mass of blossom now, and two of the sprays, either from situation or from the greater maturity of their flowers, had quite a number of beetle visitors; among others a solitary *Leptura 6-maculata*, and (better still) along with two specimens of *Leptura proxima*—the first that season—behold! *Leptura chrysocoma*. This last I had never taken, though, two or three seasons before, I had heard of a lucky collector in Port Hope making quite a haul.

Altogether the experience of this first season served only to enshrine the Wood of Desire in my heart as a haunt that age could not wither nor custom stale. Again and again in fall and winter I found myself longing for the spring. Alas! its coming was advertised in the almanac weeks before it appeared, and it was actually Victoria Day before I exchanged New Year greetings with my inamorata.

Now perhaps it may spell for you a cozening fancy—the glamour of imagina-

tion—but so sure was I the mere sight of this wood must kindle in everyone longings ardent as my own, that I got together a picnic party to visit the place. The approach by the gravel road was admitted on all sides to be lovely, but just as we reached the outposts of beech and maple, our foremost team began to kick and plunge; we were ambushed, and next moment all our cavalry was thrown into confusion and we were hotly engaged in hand conflict with hordes of fierce mosquitoes. Further in, as I knew, the swamp was even denser; where horses were too restive to be tethered, it was impossible for bipeds (at least the petticoated variety) to bivouac in any comfort; so we beat a hasty retreat to the upland pasture. Here a strong wind, coming to our support, checked the advance of the foe; and here, much abashed, in the lee of a snake fence, we rallied our forces and sat down to an *al fresco* banquet.

A diner at Delmonico's would have turned up the nose at our bucolic bill of fare; but nature, kind indeed to all her children, added, in the keenest of outdoor appetites, a relish to this plain and homely food not a city in the world could supply; she even provided us, in true up-to-date style, with refreshing interludes of music; a rare treat, in the form of a series of solo selections. For without being closely attentive we were yet, throughout the repast, fully alive to what seemed the clear carol of a robin.

The song came from the leafy gable of a Balm of Gilead beside the road; the same hidden turret, the same sweet notes I had marked the June before. The very persistence of the song at last caught and held the attention of us all; closely studied it was certainly no robin's, being sweeter in quality and of far greater range; soft as the fluting of a bluebird, yet full and rich (almost) in tone as an oriole's, wonderfully varied, still more wonderfully sustained, came the notes of the singer, a silvery shower of sound. We managed, two of us, to draw close enough to note the bird's outline as he sat on a spray near the top of the tree; then, at length, he paused in his song and flew; as the wings were spread in his first movement we could see a streak of white across them.

It was indeed the Rose-breasted Grosbeak; a week or two later I had an opportunity of studying him at leisure through field-glasses as he sat on this his favorite perch—singing (doubtless) to a mate on the nest. The black of the head and throat, the white of the lower body, and in delicious contrast a splash of rich crimson on the upper breast, left no doubt of his identity, even had the vaulted boldness of his bill not been in evidence. Mr. Schuyler Matthews contends that the bird owes his power as a songster—a certain resonance and fulness of tone, perhaps—in some measure to the shape of his beak; nor need the contention be thought fanciful; the English bullfinch, for one, might be cited in support.

Some weeks later, when halcyon days had really come to stay, and I ventured to suggest to some of my friends that we forgather again at the Wood of Desire, they one and all refused. In their memory the song of the Grosbeak wakened no echo, but the winged darts of Liliputian hosts renewed all their venom, and my rambles since Victoria Day have been companionless.

If I were put in the witness box and cross-examined by some matter-of-fact plaintiff's counsel, many startling admissions would doubtless be made to appear; as, that the round trip involves no less than 15 miles of tramping; that often I have been so parched with thirst as to lie down and lap, at the girdling moat, water that was tepid and tasted of cows; that once, on venturing a few rods in towards an enticing nook, the gravel road I had left vanished (by some sinister necromancy) as completely as the highway out of which Childe Roland turned aside in his quest of the Dark Tower, and I was left for over an hour to wade knee deep and flounder

to the waist through mazy labyrinths of swamp; that no sooner had I escaped this involuntary dipping, than a thunderstorm came up and baptised me all over again, a cold douche and a shower (so to speak) being thrown in gratis on the top of the foot and hip baths already so lavishly provided; and again, that, early and late, mosquitoes and deerfly swarm there in countless myriads.

Damning evidence to you jurymen, perhaps; to me, proof positive of Mr. Bumble's famous apothegm, "The Law is a hass." One tithe the facts in the other scale of the balance would serve to kick the beam. Witness the troop of black squirrels I met, hotfoot at a game of tag; the little couple of fellow-entomologists I surprised, pouncing on ground beetles in the carpet of dead leaves, as pretty a pair of young skunks as you would wish to see anywhere; the bittern I watched stalking frogs, with all the cunning and the zest of a human hunter; the hen partridge that held me at bay to cover the retreat of her brood; the whip-poor-wills, flitting in ghostly silence from their nesting place; the grosbeak, in his leafy hermitage, all its belfries a-peal with melody; to say nothing of the flower-clusters of chokecherry I found, sheltering in their midst the rare little *Anaglyptus* I had vainly sought for eight years and now took nearly a score of; and the windfall of beech trees I happened on last July—an illustration (come to think of it) of the struggle for existence, no less striking, if less gruesome, than the fly-blown carcase already writhing with new life of an alien order—three giant beeches, thrown in some titanic westling-bout with Boreas, their dying shafts alive with Longhorns, Buprestids and other brooding insects; gangs of pigmy foresters, drilling, boring, and charging, "throng" at their self-imposed task of wood-scavenging; strange medley of life in death, such as fed the melancholy of Shakespeare, when he wandered, moralising, with Jacques through the Forest of Arden.

These and a score of other scenes remain, tapestried in the rich brocade of memory; while all the tale of misadventures has long faded into nothingness. Every trip I made last June and July brought me home at nightfall, footsore indeed, but laden with treasure-trove, and eager for the morrow's sun, to light up once more that land of glamour, elf-haunted still and fraught with mystery, the Wood of Desire.

INSECTS AS MATERIAL FOR STUDIES IN HEREDITY.

W. Lochhead, Macdonald College.

For some years I have given attention to problems of heredity, and have been impressed with the importance of the place insects have taken in the solution of some of the problems. I thought, therefore, that it might be of interest if I brought together the many scattered references in current literature to the investigations that have been made with insects.

Tower's Experiments.

No question in heredity has been more keenly discussed than "Are acquired characters transmissible?" The neo-lamarckians assert that characters impressed upon an organism by its environment may be and often are transmissible. Weismannists, on the other hand, maintain that such characters are never transmitted. Tower's investigations set forth in "An Investigation of Evolution in Chrysomelid Beetles of the Genus Leptinotarsa" (Carn. Inst. Publ. No. 48) are interesting in this connection. He subjected beetles, when their reproductive

organs were developed to a certain stage, to unusual conditions of temperature and moisture. As a result variations appeared in the offspring in regard to color markings and certain details of structure. These variations, moreover, were not all alike; some were immediate, others appeared after a time; some of the germ cells were affected, others were not. But the important point was that the variations produced did not revert to the original parent forms in subsequent generations. These experiments indicated that *environmental stimuli may, under certain conditions, produce germinal variations.*

Standfuss and Fischer, by changing the temperature and food of the larvæ of Vanessa and Arctia, induced in the following generations certain variations which persisted even when crossed with the parent form.

The investigations of Johannsen, of Copenhagen, with Pure Lines of beans and barley showed that variations within a Pure Line are not inherited, and that they have little or no influence on the permanent improvement of a race. In Tower's experiments with Pure Lines of the Colorado Potato Beetle (*Leptinotarsa 10-lineata*) dark to light colored variations appeared in the same Pure Line. When dark males and females were mated the progeny were not dark, but they fluctuated about the average of the Pure Line, even after twelve generations of such mating. *Tower's results, therefore, confirm the conclusions reached by Johannsen.*

Selection Value of Variations.

Darwinism has been criticized on the ground that variations often occur which cannot possibly be of value to their possessors in the struggle for existence. Kellogg and Bell in their "Studies of Variation in Insects" made a careful scrutiny of the color patterns of 1,000 specimens of *Hippodamia convergens* and found 84 aberrations of pattern varieties, ranging all the way from no spots to eighteen spots, although twelve is the species character. If some of the intermediate patterns should disappear the systematist would have data for making several new species. Other forms studied showed variations in antennal structure, spinal armature of tibiæ, and venation. The conclusion is that "continuous" variations are in all probability not the foundation stones of new species. This view has of course been emphasized by De Vries, Johannsen, Morgan and others.

Examples of Mendelism.

Toyama's experiments with Siamese silk moths are interesting. He paired a moth with yellow cocoons with one having white cocoons. The offspring produced only yellow cocoons. In the next generation some of the cocoons were yellow and some were white in the proportion of 3 to 1. The whites bred true, while the yellows broke up again, yellows and whites in the usual ratio.

Miss McCracken's work with spotted and black varieties of *Lina lapponica* is also confirmative of Mendel's laws, the spots being dominant and the black recessive.

Coutagne, 1902, found that when a silk moth whose larvæ had transverse stripes was crossed with one whose larvæ were white, the striped form was dominant. Toyama also found the striped form dominant.

Standfuss's experiments in crossing the moth *Aglia tau* with its dark variety *lugens* do not harmonize with those of Doncaster with Abraxas. The dark color of *lugens* was dominant over the light color of *tau*, but in subsequent matings of heterozygous *lugens* and with *tau* the results were such that cannot be brought into line with Abraxas.

Lutz found that when a normal *Crioceris asparagi* with three yellow spots on blue-black elytra was crossed with a variety where the upper spot was united with the middle one, the normal form was dominant. Intermediate conditions occur, but these may be heterozygous forms.

In-Breeding.

Darwin's memorable work on cross-fertilization with morning-glories, pansies, cabbage, lettuce, buckwheat and beets showed conclusively the value of cross-fertilization over self-fertilization in the maintenance of the vitality of these plants. But it has also been shown that many self-fertilizing plants, like tobacco, wheat and barley, are vigorous and have retained their vigor for thousands of years. Dr. East says very properly that Darwin's phrase "Nature abhors perpetual self-fertilization" should read: "Nature resists any sudden change in long established conditions."

Regarding the effects of in-breeding among animals differences of opinion exist, but Mendelism has cleared away some of the difficulties. It shows that in-breeding in itself is not necessarily injurious, but great care must be exercised to prevent injury. The duplex dose of determiners develops prepotency in all characters, good and bad alike.

Castle in-bred Drosophila for about sixty generations without any appreciable loss of vitality.

The Sex Chromosome.

On account of the fact that approximately the same number of males and females of the human species are born, students of heredity have suspected that sex is a character dependent upon factors which act in a Mendelian manner. The explanation of this equality of sexes was forthcoming by comparatively recent researches in which insects played an important part. Henking, in 1890, discovered two kinds of sperm cells in the firefly, *Pyrrhocoris*. McClung, in 1902, found two kinds of chromosomes in the sperm cells of the grasshopper. Stevens, in 1905-1908, found accessory chromosomes in certain species of aphis and Diptera. Wilson, in 1905-1907, discovered different kinds of chromosomes in certain Hemiptera; and Morgan, in 1908, described two kinds of sperm cells in Phylloxera. Later researches by Doncaster, Raynor, Morgan and others have extended the list.

This accessory chromosome has been called the *sex* or *X chromosome* inasmuch as its presence in the germ cell is believed to determine the sex of the offspring. In most animals, including man, all the female germ cells contain an X chromosome, while it is present in only half of the male germ cells. On the other hand, in chickens, ducks, canaries, and in the English currant moth (Abraxas) all the male germ cells, but only half the female germ cells, contain the X chromosome.

In the first case investigations have revealed the fact that when fusion occurs between an egg and a sperm, both containing an X chromosome, the result is a female, but when an egg and a sperm without an X chromosome fuse the fertilized egg has only one X chromosome and the result is a male. In fertilization, therefore, the chances are that approximately an equal number of males and females are produced, as shown by diagram:

O = egg cell; S. sperm with an X chromosome.
s = sperm without an X chromosome.
Z = zygote with two X chromosomes.
z = zygote with one X chromosome.

		S	s	= male gametes.
Female gametes	O	Z	z	= 2Z + 2z, giving an equal number.
	O	Z	z	

In the second case where the female is heterozygous for sex and the male homozygous, the chances in fertilization are again approximately an equal number of males and females.

O = egg cell with an X chromosome.
o = egg cell without an X chromosome.
S = sperm cell with an X chromosome.
Z = zygote with two X chromosomes (male.)
z = zygote with X chromosome (female.)

		S	S	= male gametes.
Female gametes	O	Z	Z	= 2Z + 2z, an equal number of males and females.
	o	z	z	

Heredity in the Aphids and Bugs.

The life-history of aphids is well known. The fertilized egg hatches out a female, the stem-mother, the following spring, followed by a succession of generations of females. On the approach of autumn a brood of sexual males and females appears. The explanation of these phenomena is not clear, but some progress has been made in clearing the mystery. Morgan has shown that the spermatids of Phylloxera are of two kinds, but those containing no accessory chromosome degenerates. Consequently only those containing an accessory chromosome take part in fertilization, and the fertilized eggs produce females. The problem of the production of the males parthenogenetically, however, at the approach of autumn has not yet been solved. It is probable, however, that external or environmental factors are to some extent responsible. In *P. caryaecaulis* one stem-mother gives rise to the line ending in sexual females, and another stem to the line ending in the males. On the other hand in other species of Phylloxera and in many aphids the same stem-mother may produce both lines.

In this connection it is interesting to observe the production of males and females among bees, wasps and ants. It is well known that fertilized eggs of the queen bee produce females, and unfertilized eggs males. The mature egg has one sex chromosome, consequently the male cell has but one, but when the egg is fertilized by a male cell and product has two sex chromosomes, characteristic of the cells of a female bee.

Foote and Strobell have recently made interesting studies of two species of *Euschistus*. The male of *variolarius* has a well-defined black circular dot on the sixth segment of the abdomen, but in both sexes of *servus*, the other species, the spot is absent. When a female *variolarius* was crossed with a male *servus* many of the F_1 hybrids showed the spot. Again, the cross between a pure male *variolarius* and the F_1 female and spot appears. In the F_2 generation some specimens showed the spot, while others did not. A satisfactory explanation of the inheritance has not yet been given.

Experiments with the English Currant Moth.

The work of Doncaster and Raynor (1908) in connection with the crossing of two varieties or sub-species of Abraxas, *grossulariata* and *lacticolor,* was important in that it furnished additional evidence that certain characters are sometimes linked up with sex or with the sex factor. For example, color-blindness in man seems to be linked up with sex. Men cannot hand on the defect without having it, whilst women can. Doncaster and Raynor's results are explained on the assumptions that the female is heterozygous for sex, femaleness being dominant, the male a homozygous recessive, and the factor for color for *grossulariata* is dominant. The gametic formulæ for the crossings are given below:

C. = dominant factor for color (grossulariata.)
c. = recessive factor for color (lacticolor.)
F.f. = sex factors in female.
F.F. = sex factors in male.

Case I. Grossulariata (male) x lacticolor (female).

Female gametes	CF	CF
CF	Gross. male	Gross. male
cf	Gross. female	Gross. female

CF CF = male gametes.

= all grossulariata (heterozygous) 50% female, 50% male.

Case II. F1 Grossulariata (male) x F1 Grossulariata (female).

Female gametes	CF	cF
Cf	Gross. female	Gross. female
cF	Gross. male	Lact. male

CF cF = male gametes.

= 50% grossulariata females (½ normal, ½ heterozygous). 25% gross. males (heterozygous, 25% lacticolor male (normal).

Case III. F1 Grossulariata (male) x lacticolor (female).

Female gametes	CF	cF
cF	Gross. male	Lact. male
cf	Gross. female	Lact. female

CF cF = male gametes.

= 25% gross. female (heterozygous), 25% gross. male (heterozygous), 25% lact. female (normal), 25% lact. male (normal).

Case IV. Lacticolor (male) x F1 Grossulariata (female).

Female gametes	cF	cF
Cf	Gross. female	Gross. female
cF	Lact. male	Lact. male

cF cF = male gametes.

= 50% gross. heterozygous females. 50% lact. heterozygous females.

An interesting case arose in the reciprocal of Case I when a pure wild grossulariata (female) was crossed with a lacticolor (male). The result was the same as in Case IV, showing that the wild grossulariata female is heterozygous with regard to that color.

Experiments with the Pomace Fly.

Morgan's recent investigations with hybrids of *Drosophila ampelophila,* the common pomace fly, have added much to our knowledge of factors in heredity. He found that each visible character is due to the action of a number of factors in the germ plasm, each factor in turn influencing a large number of other traits. Moreover, these factors are linked together in groups, in chromosomes, where they are arranged in a linear series, sometimes changing places by crossing over. With Drosophila, which was normally red-eyed, there appeared in the course of breeding experiments as many as 25 distinct mutations in this eye-color. Morgan supposes, therefore, that at least 25 factors are concerned in the production of this red eye, and that when a single one changes a different color is obtained. This one factor, however, may be called the *unit* factor for this particular color, so it may be treated in a simple Mendelian factor in segregation. The following examples illustrate one of the simpler cases of inheritance:

Case I. Red-eyed (female) with white-eyed (male).

Female gametes	rF	rf
RF	Red-eyed female	Red-eyed male
RF	Red-eyed female	Red-eyed male

rF, rf = male gametes.

Progeny all red-eyed.

The diagram of the F_2 generation is:

Female gametes	RF	rf
RF	Red-eyed female	Red-eyed male
rF	Red-eyed female	White-eyed male

RF, rf = male gametes.

= 50% red-eyed females.
25% red-eyed males.
25% white-eyed males.

Case II. White-eyed (male) x F_1 red-eyed female (heterozygous).

Female gametes	rF	rf
RF	Red-eyed female	Red-eyed male
rF	White-eyed female	White-eyed male

rF, rf = male gametes.

= 25% red-eyed females.
25% red-eyed males.
25% white-eyed females.
25% white-eyed males.

Case III. Red-eyed (male) x white-eyed (female).

Female gametes	RF	rf
rF	Red-eyed female	White-eyed male
rF	Red-eyed female	White-eyed male

RF, rf = male gametes.

= 50% red-eyed females.
50% white-eyed males.

showing that the red-eyed male parent is heterozygous for color.

Case IV. Red-eyed (male) x F_1 red-eyed (female) heterozygous.

		RF	rf
Female gametes	RF	Red-eyed female	Red-eyed male
	rF	Red-eyed female	White-eyed male

= same as the F_2.

If a white-eyed male Drosophila is mated to a red-eyed female the offspring are red-eyed. If these are in-bred all the F_2 daughters are red-eyed, but half the sons are white-eyed. "In a word, the grandfather transmits his characters visibly to half of his grandsons but to none of his granddaughters." (Morgan.)

R = dominant unit factor for red eye color.
r = recessive unit factor for white eye color.
F.F = sex factors in female.
F.f = sex factors in male.

The experiments of Morgan and his colleagues with Drosophila are perhaps the most important in recent genetic research. They are valuable both by reason of the large number of specimens under observation and on account of the significance of the results. Bateson says: "If we accept the whole scheme of interpretation without reserve we are provided with a complete theory of heredity, so far as proximate phenomena are concerned."

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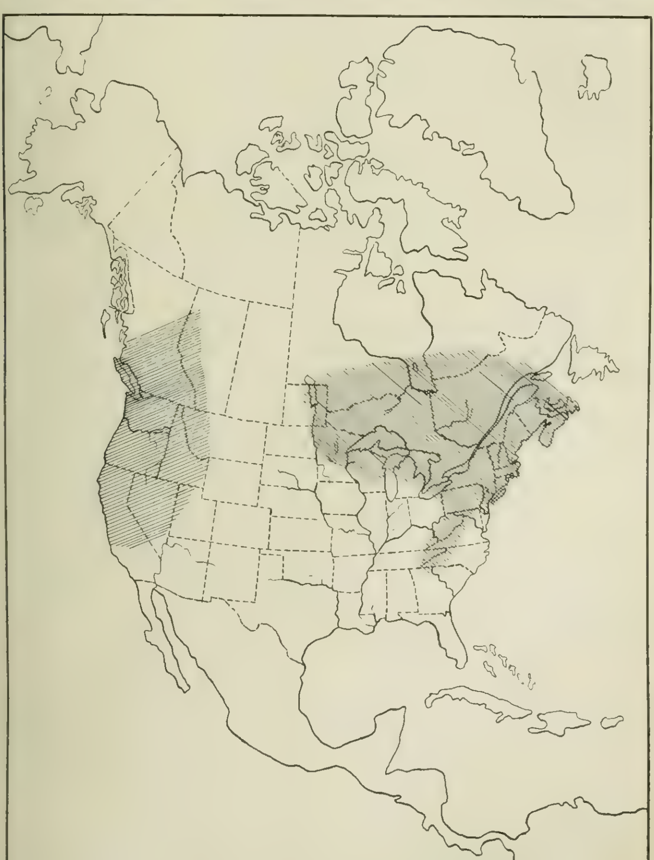
AN HISTORICAL ACCOUNT OF THE FOREST TENT CATERPILLAR AND OF THE FALL WEBWORM IN NORTH AMERICA.

A. B. Baird, Dominion Entomological Laboratory, Fredericton, N.B.

Introduction.

Since 1911, the Entomological Branch of the Dominion Department of Agriculture has been conducting a study of the natural control of two common insects that from time to time are very injurious to forest, orchard, and shade trees throughout the Dominion. The work is being carried on from the Fredericton



Map of North America, showing the three regions referred to in the text.

laboratory by Mr. J. D. Tothill and his assistants, and is under the general direction of the Dominion Entomologist, Dr. C. Gordon Hewitt.

The insects in question are the Forest Tent Caterpillar and the Fall Webworm. The object of the work has been to study the control of each insect at the same places for a period of consecutive years. The work has resolved itself into a study of the causes of outbreaks of these and other insects, and of the factors that in the natural course of events, cause these outbreaks to subside.

In 1911, when the study was commenced, both the Forest Tent Caterpillar and the Fall Webworm were exceedingly abundant, and were doing great damage throughout the Eastern United States and Canada. Since then they have become less and less numerous and in 1915 there remained only a few local infestations and practically no damage was reported.

This story of great abundance followed by a period of scarcity is merely a repetition of a story that has been told and retold many times in the past history of this continent. It is the purpose of this paper to give an historical account of these two insects as gleaned from the records of the White Man written during his few centuries of residence in this land.

For the purposes of this account it has been found convenient to divide the continent into three regions. On the map (p. 73) these are indicated, the Eastern and Western being marked with parallel lines and the Central occupying the intervening territory. The Regions are treated separately. The accounts of these insects are much more complete and satisfactory for the Eastern Region than for either of the others. A glance at the charts (pp. 76, 81) will show to what extent the abundance of the insects has been uniform for the three Regions.

In these charts the term "local ravages" has been used to designate outbreaks which are recorded as occurring only in smaller sections of the main divisions, or Regions. As will be noticed these outbreaks occurred largely previous to 1860, and there are at least two explanations for their seemingly local distribution: (1) The limited number of observers recording such data prior to that time and (2) The more or less limited food supply of the insects. It seems quite probable that the food plants of both species, but especially of the Forest Tent Caterpillar have greatly increased with the spread of civilization. This question is, however, too many-sided to permit of a full discussion here and will be left for another paper, dealing with this subject, which it is hoped will be published from the laboratory at a later date.

The author wishes to take this opportunity of thanking Dr. C. J. S. Bethune, Professor of Entomology at Guelph, for his kindly assistance in connection with the library work at Guelph. He also wishes to thank Mr. Tothill for his many helpful suggestions and kindly criticisms.

Forest Tent Caterpillar.

Eastern Region.

The original habitat of the Forest Tent Caterpillar in North America seems to have been in the Eastern Region, for it is here that we find its ravages first recorded.

The first authentic record of the presence of the Forest Tent Caterpillar is that compiled from earlier observations by Mr. Abbot and published by Sir J. E. Smith in 1797 in his 'Lepidopterous Insects of Georgia.' He gives good colored figures of the larva and imago, and states that "This kind is sometimes so plenti-

ful in Virginia as to strip the oak trees bare but is rather rare in Georgia." This makes it certain that there were outbreaks of the insect, in Virginia at least, previous to 1797; and that it was not so abundant farther south. As early as 1791 there was an outbreak of an insect in Vermont which was probably the Forest Tent Caterpillar, and may have been a part of the last outbreak noticed by Mr. Abbot in Virginia.

We have no further record of the insect until 1820, when it was noticed in Massachusetts. In the 'Entomological Correspondence of T. W. Harris,' we find a description of the species and the following notes on its history, "The moths appeared about the last of June, 1820. . . . One cast its skin June 13th and came out an imago July 1st, 1821." "Found the larvæ on the apple tree, June 3rd, 1826." Harris again mentions it in his "Treatise on Insects," 1841, and publishes an account of it in the "New England Farmer," 1844, which would indicate the presence of the caterpillar in Massachusetts at that time.

The earliest authentic record of an outbreak in New York is given by Fitch in his Second 'Report of the Insects of New York,' pp. 198-199. He says, "his neighbors state that this species gnaws the stems of young apples causing them to fall as well as eating the leaves." This was probably a part of the same outbreak as that recorded from New Hampshire in 1854 by Eaton ('Trans. N. H. State Agr. Soc.' 1854-1855, pp. 199-207). There is evidence that small outbreaks had previously occurred in New York for in the *Country Gentleman* of 1861 (Vol. 45, p. 299) "Acer" says with reference to this species, "These insects have disappeared three times during the last thirty years." The first of the outbreaks thus implied probably occurred between 1826 and 1830, the second between 1840 and 1844, the third was the one referred to by Fitch and Eaton.

In his 'Fifth Report of the Insects of New York,' 1859, Fitch says of these caterpillars, "a few are seen every year and occasionally there is a season when they are more common but never numerous." He also states that they were about the same in Baltimore, nothing approaching stripping having been known in that vicinity in his generation.

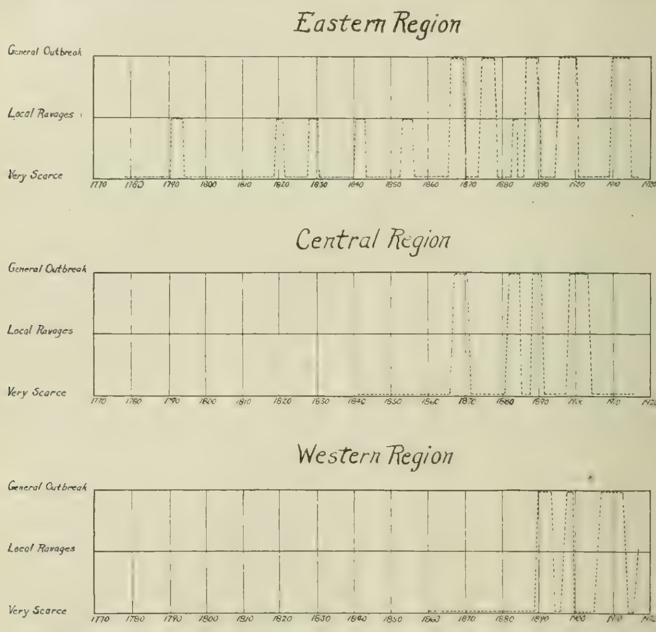
The *Country Gentleman* of 1868, makes several references to the severe outbreak of that year in New York. The caterpillars were reported as "more numerous and destructive in New York State than ever before," and it is also stated that "they have twice disappeared in this place."

From the foregoing notes on its history we have reason to believe that the ravages of the Forest Tent Caterpillar were not very severe previous to 1859, as there is no record of stripping except that by Smith and Abbot, concerning the oaks in Virginia. These ravages were probably restricted to a few of the north-eastern States. We note, however, that the insect was present previous to 1797, that there were outbreaks of a more or less serious nature in Massachusetts in 1820; in that State and in New York between 1826 and 1830; again between 1840 and 1844; and about ten years later in New Hampshire and New York.

The next outbreak, noted in the *Country Gentleman* of 1868, was much more widespread and severe than any of the preceding. Its ravages now extended over the entire region. The editor of the *Canada Farmer* reported "many orchards defoliated" near Toronto in June of that year. Walsh (*Practical Entomologist* 2, pp. 112-113) noted its occurrence "in large numbers" in the orchards in Maine in 1866 and in the following year on oak in Virginia and in orchards in New York. Brackett[1] reports their ravages in Maine in 1867. Riley in his

[1]1867. Brackett, G. E., Am. Journ. of Hort., Sept., 1867.

'Third Report of the Insects of Missouri,' recorded them as very destructive in the Eastern States in 1867 and 1868. In his second Report in 1870, he says regarding the caterpillars, "For a number of days last June in Western New York they might have been seen marching single file up the railroad track on Pilot Knob in the scorching rays of the noon day sun." Bethune ('First Ann. Rep. Ent. Soc. Ont.,' p. 15) reported them as very abundant in Western Ontario in 1870, but said they had decreased east of Toronto. In 1872 Saunders says of the same district ('Can. Ent.,' 4, p. 134) "We have not met with a single full grown specimen this year although in years past they have swarmed on our trees and fences." This outbreak thus covered a period of about five years, 1866 to 1870, and the resultant damage was very much greater than any previously reported from this species.



History of the Forest Tent Caterpillar in North America. The dotted lines indicate the abundance of the insect.

Four years after their disappearance, Mr. H. H. Lyman, of Montreal, published an account of the unusual abundance of the insect. In the *Canadian Entomologist*, Vol. 6, p. 158, he says, "The caterpillars of this pest are swarming on almost every description of tree or shrub in the vicinity, many trees being completely denuded of foliage."

This was the first notice of another outbreak and the following notes throw some light on its severity and distribution. "The Forest Tent Caterpillar was excessively abundant and destructive to fruit and forest trees in many parts of

Ontario." (Bethune, 'Ann. Rep. Ent. Soc. Ont.,' 1875, p. 7). "Very serious ravages of this insect in Maine during the past two years." (Fernald, 'Agr. Maine,' 1875-1876, pp. 19-21). "Millions upon millions of them in Western Ontario," (Saunders, 'Ann. Rep. Ent. Soc. Ont.,' 1877, p. 4). "Very active and on constant parade over shrubs, fields, orchards, and gardens. They are recruited so plentifully from the forests, that we fairly sicken of the fight and despair of the prospects of victory." ('Gott. Ann. Rep. Ent. Soc. Ont.,' 1877, p. 41). "Had a fire passed through our orchards it could not have left our apple trees under more barren poles." (Burnet, 'Rep. Fruit Growers' Assn. Ont.,' 1877, p. 10). "Not so numerous as last year. . . . Mites destroyed many of the eggs and severe frosts in May, fungus diseases, parasites and birds, killed off many of the larvæ," (Saunders, 'Ann. Rep. Ent. Soc. Ont.,' 1878, p. 5 and pp. 28-30). "The tent caterpillars have almost entirely disappeared." (Saunders, 'Ann. Rep. Ent. Soc. Ont.,' 1880, p. 9). In these notes we have given very briefly the story of this outbreak which extended from 1874 to 1878 and did enormous damage over the greater portion of the Eastern Region.

In the year 1884 the insect was reported as very injurious in New Brunswick and Nova Scotia by Fletcher ('Rep. Ent. and Bot.,' 1885, p. 32). It was also referred to by Packard in the 'Fifth Report of the U. S. Entomological Commission,' pp. 117-118. This outbreak seems to have been quite local in character, but may have been the beginning of the next general outbreak, which began to attract attention in Vermont in 1886, when Lintner reported it as causing considerable injury to apple trees in that State. By the following year its ravages had spread over the entire Eastern Region, and in fact over the entire continent. Fletcher ('Rep. Exp. Farms, Canada,' 1887, p. 29) says, "The tent caterpillars were in great abundance all over Canada during the past season and seemed to attack almost every kind of deciduous tree." In 1888 it was reported as abundant in Maine ('Me. Agr. Exp. Stn. Rep.' 1888, p. 164) and the following year its ravages in that State were extremely severe. Most of the orchards and all the poplars, oak, cherry, and many other deciduous trees were completely defoliated in several sections, and railway trains were held up on several occasions for two and three hours at a time, by the innumerable legions of them crossing the tracks. Riley and Howard 'Insect Life,' 2, pp. 58-59). The same year Caulfield (Montreal) reports them as "all too common on our forest trees," ('Ann. Rep. Ent. Soc. Ont.,' 1889, p. 64). This was the end of the general outbreak for Bethune on page seven of the "Annual Report of the Entomological Society of Ontario," 1890, says "The tent caterpillars have been remarkable for their absence or rarity in all parts of Ontario." Only two local infestations are recorded that year, one being in the Penobscot Valley, Maine ('Me. Agr. Exp. Stn. Rep.,' 1890, p. 138), and the other in Washington County, New York (Lintner, '6th Rep.,' p. 106).

In 1891 a very severe local infestation was reported by Riley and Howard ('Insect Life,' pp. 477-478) on oak and gum trees in Carolina during which train traffic was seriously interfered with for several days.

In 'Bulletin No. 76 of the Vermont Agricultural Experiment Station' (1900) Perkins says that the insect began to attract attention in Vermont in 1895, and its ravages on maple became very extensive the following year, but it was not until 1897 that we again find general mention of the ravages of this pest. In that year Fletcher[1] reports them as "so abundant at Ottawa that they actually

[1]1897, Fletcher, Ann. Rep. Ent. Soc. Ont., p. 34.

starved themselves out by stripping." Harrington (Ont.) also reports the appearance of the caterpillars "in great numbers" on poplars and other trees. Perkins[1] in the same year reports it widely distributed over Vermont, many woods and orchards being entirely stripped. Their depredations were even more severe the following year, when Fletcher says ('Ann. Rep. Ent. Soc. Ont.,' 1898, pp. 84-85) "the Tent-caterpillars have been even more abundant than last year in almost every Province of Canada." Hutt and Moffat, ('Ann. Rep. Ent. Soc. Ont.,') both report them being so abundant as to interfere with the running of trains in many parts of Ontario. Their excessive destructiveness is reported by Weed in New Hampshire ('Bull. N. H. Agr. Exp. Sta.,' No. 59, pp. 199-201). Felt in his Fourteenth 'Report of the State Entomologist of New York,' says. "the ravages of 1897 and 1898 have been unprecedented in the annals of the State." In 1899 he[2] reports serious outbreaks, particularly in the Catskill Mountains and in the borders of the Adirondacks. "Ten cents per quart," he says, "were offered for the cocoons in many villages." The reports of Lowe ('Geneva N. Y. Bull.' 159) and Slingerland ('Cornell Exp. Sta. Bull.,' 170, pp. 559-564) corroborate those of Felt. Perkins[3] reports very great damage in Vermont in 1898 and 1899 and also states that "There have been occasional outbreaks since 1791, but the ravages of the present exceed any of the past both here, and in New York, Maine and Canada." Similar reports from other sections clearly point to this outbreak as exceeding both in severity and in extent, the ravages of any of the preceding ones. In 1900, the outbreak subsided, and in 1901 the caterpillars were reported as very scarce, all over the country. Three years later in the 'Annual Report of the Entomological Society of Ontario,' Fletcher states "not a moth or caterpillar of this species was seen at Ottawa this year," and in 1905, Evans ('Ann. Rep. Ent. Soc. Ont.,' p. 50) says, "The Tent caterpillar seemingly has disappeared entirely."

The insect did not again become numerous until 1910 when Hewitt ('Ann. Rep. Ent. Soc. Ont.,' p. 29) reported its occurrence in very large numbers in the Eastern Provinces and British Columbia. This marks the beginning of our latest outbreak in the Eastern Region, and its ravages are too well known by this generation to require much discussion here. Gibson reports hordes of the caterpillars and says, ('Ann. Rep. Ent. Soc. Ont.,' 1912, pp. 15-16) "It is the most remarkable outbreak of an injurious insect on record at Ottawa," and further stated that in the Gatineau Valley especially near Chelsea, many trains were held up, the evening passenger trains having been forced to use two and sometimes three engines in order to get along at all. Lochhead reported it equally bad in Quebec and their depredations were just as severe in New Brunswick and the Eastern States. Their ravages began to decrease in 1914, and in 1915 the insect had practically disappeared.

Central Region.

There seems to be no record of the Forest Tent Caterpillar in the Central Region until 1867, but it had no doubt been present in greater or less numbers for some time previous to this.

In his Third 'Report of the Insects of Missouri,' Riley reported this species as very destructive in 1867, and also the following year, in Arkansas and Missouri. The *American Entomologist,* Vol. 1, p. 208, records an outbreak of the insect in

[1]1897. Perkins, G. H., Vt. Agr. Exp. Sta., Bull. No. 60, p. 529.
[2]1899. Felt, E. P., Bull. No. 20, N.S., U.S. Div. Ent., pp. 60-62.
[3]1900. Perkins, G. H., Vt. Agr. Exp. Sta., Bull. 76, pp. 113-137.

Missouri in 1869, and in Vol. II of the same publication (1870) Riley states that the infestation was severe in Arkansas and Illinois, both that year and the preceding, and that it had been very destructive in Missouri during the past three years. Riley again reports it, ('Report Insects of Missouri,' VIII, pp. 22-26) as sometimes appearing in countless numbers in the oak forests of the South, and says, that in 1872 it was so abundant at Memphis, Tennessee, as to hold up trains on several occasions.

It may be well here to note that the above-mentioned outbreak was co-incident with the first general outbreak in the Eastern forests.

No further ravages of the insect are recorded until 1883, when Forbes reports them ('Thirteenth Ann. Rep. of the Illinois State Ent.,' 1883, p. 10) as having made a frightful inroad upon the apple orchards in Southern Illinois. He also mentions the same outbreak in his Seventeenth 'Report of the Insects of Illinois,' 1885, p. XIII. In his Fourth 'Report of the Insects of New York,' Lintner refers to this infestation in Illinois and states that it was arrested by a contagious disease known as muscardine.

As previously noted in the history of the Eastern Region, Fletcher, in 1887, stated that the Tent Caterpillars were in great abundance that season all over Canada so they were in all probability present in the Central Region or in the northern part of it at least. Bruner notes their occurrence ('Neb. Agr. Exp. Sta. Bull.,' 14, pp. 33-38) in Nebraska in 1890, and says they are frequently met with upon the prairies several miles from natural groves. In 1891, Murtfeldt ('U. S. Div. Ent. Bull.,' 26, pp. 40-41) reported a remarkable outbreak in Minnesota. She says the papers reported armies of them throughout the forests of the North-west, and a large portion of the forests were defoliated as well as many orchards.

The next outbreak recorded is in 1898, when Pettit[1] reports a severe infestation in some parts of Michigan. The same year Lugger ('Minn. Agr. Exp. Sta. Bull.,' 61, pp. 194-199) said the insect was fairly abundant in Minnesota, being more common than the Orchard Tent. Three years later, in the "Annual Report of the Entomological Society of Ontario," p. 119, Gregson states that the caterpillars were abundant that year in Assiniboia, and the insect was recorded for the first time, in Red Deer and Lacombe districts. Hudson[2] found a brood on *P. tremuloides* at Millarville, Alberta, in 1902; and Fletcher ('C. E. F. Report,' 1904) mentions finding what he thought was this species near Edmonton. "The moths," he states, "were in thousands just emerging." From these notes we would infer that the outbreak was quite general over the Central Region.

The infestation which was so severe in the Eastern Forests from 1910 to 1915, does not seem to have extended its ravages to the Central Region, and no further outbreaks have so far been recorded.

Western Region.

No information is available concerning the early history of this pest in the Western Region. The first reference to it is found in Saunders' "Insects Injurious to Fruits," published in 1883. In this he gives an account of the Forest Tent Caterpillar, and states that it is often very abundant in the West. This does not give us definite data concerning any outbreak, but assures us that the insect

[1]1898. Pettit, R. H., Mich. Agr. Exp. Sta., Bull. 175, pp. 349-350.
[2]1906. Dod, F. H. Wolley. Canadian Entomologist, XXVIII., N.o 2, p. 54.

was present for some time previous to that date, and that it was not so abundant some years as in others.

The first authentic record of an outbreak is given by Koeble, who states, ('U. S. Div. Ent. Bull.,' 23, p. 42) that this insect was found very abundant on Crataegus, alder, hazel and other trees in Washington in 1890. The same outbreak is recorded two years later, in the Third 'Annual Report of the Horticultural Society of British Columbia,' where it is stated (pp. 83-84) that "in some old orchards the foliage was entirely devoured." Also in the Third 'Report of the B. C. Department of Agriculture,' p. 1810, Mr. Wiltshire writes, "last year there were billions of these creatures and they completely stripped the crab-apple trees. This is the first year we have found them in the orchards." Dyar gives a full description of the insect in 'Psyche,' 6, 1892, stating that it was abundant in the valley of Columbia, and that in Portland, Oregon, many trees were defoliated by the larvæ. In 1894, Washburn, ('Oreg. Exp. Sta. Bull.,' 33, p. 16) records it as very abundant in Oregon, and the same year it was also reported as causing serious damage in many sections of British Columbia. From the foregoing notes we see that this outbreak was quite general over the Western Region and its ravages extended over a period of about five or six years.

Two years later, its presence was again reported in British Columbia, and the infestation had become very severe in 1898. In his 'Annual Report' for that year, Fletcher reports "countless thousands" of them, especially around Victoria and Agassiz, and, that many of the larvæ were parasitized and diseased. The following year only a few caterpillars were seen.

The history of the next outbreak is given by Tom Wilson in the 'Proceedings of the B. C. Entomological Society,' 1914, p. 37. He notes a slight infestation in 1907. The following year, a severe outbreak occurred from Washington and the United States boundary northward. In 1909 the infestation was doubled, and during the next two years enormous damage was done by the caterpillars. In 1912 the outbreak subsided and the following year they had nearly all disappeared. This outbreak thus seems to have extended over the whole of the Western Region, and its ravages greatly exceeded any previously recorded.

In 1915, the insect again began to attract attention in British Columbia, and this summer quite extensive ravages were reported on Vancouver Island. This infestation probably marks the beginning of another outbreak throughout the Western Region.

Fall Webworm.

Eastern Region.

Like the preceding insect, the Fall Webworm seems to have been originally a native of the Eastern Region. The first record we have of this species is that of Drury,[1] who described it from specimens collected in the vicinity of New York about the year 1770.

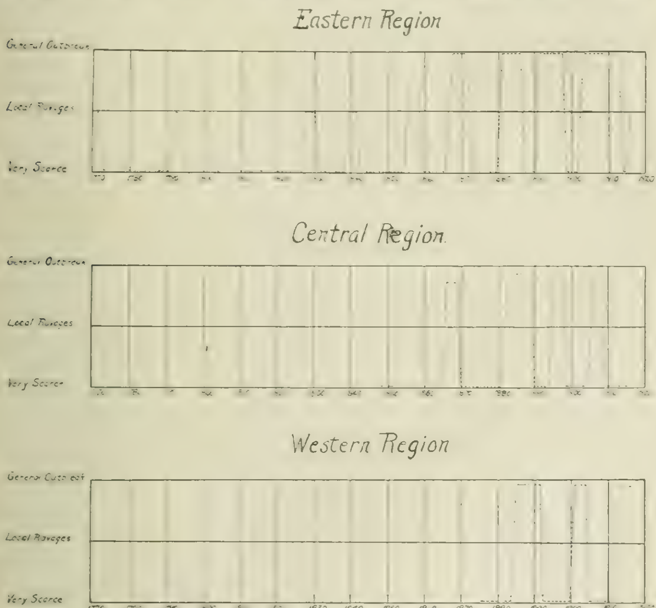
Twenty-seven years later, we find it described by Sir J. E. Smith, in his 'Lepidopterous Insects of Georgia,' as a native of Virginia and a very destructive pest.

In 1828, it was again described by Harris in the *New England Farmer*, Aug. 22nd, pp. 33-34, and six years later, he included it in his 'Catalogue of the Insects of Massachusetts,' No. 591.

[1]Drury, Ill. Nat. Hist., 1, p. 36, pl. 18 fig. 4, 1770.
Drury, Illustrations of Exotic Entomology, 1773.

Harris, again described the insect in his "Treatise on Insects," published in 1841, and here states, that the larvæ are "common and destructive little caterpillars whose large webs sometimes extending over entire branches with their leaves may be seen on our native elms and also on apple and other fruit trees."

No further notice was taken of the insect until 1856, when Fitch[1] reported it as "quite common around New York and Brooklyn," but he continues, "I have no knowledge of its occurrence north or west of the highlands." In the same year, Samuel Fowler[2] reported its ravages in Massachusetts, and in the



History of the Fall Webworm in North America. The dotted lines indicate the abundance of the insect.

Country Gentleman, Oct. 14th, 1858, p. 239, Fitch stated that it was "very abundant in New York State three or four times worse than for twenty-five years at least."

This was the first serious outbreak on record, and from the foregoing account it seems that the ravages of the insect have been increasing in severity, and that its sphere of destructive operations has widened. The next outbreak was much more widespread than any previously recorded, and extended north into Canada. It was first reported by Brackett, in the *Maine Farmer*, of Aug. 30th, 1866. The following year, Bethune states (*Canada Farmer*, Sept. 1st, 1867, p. 269) that a few colonies were reported from Hastings County, Ontario, and says that it is the first record for the insect in Canada, so far as known to him. He again

[1] 1856. Fitch Asa., 3rd, Rep. Ins. N.Y., pp. 64-66.
[2] 1856. Fowler, Samuel, 4th Ann. Rep. Sec. Mass., Bd. Agr., pp. 438-451.

refers to it in the *Canadian Entomologist*, 1868, p. 44, as "a common insect and likely to become only too familiar to apple growers." The same year, an account of the insect was given in the *American Entomologist*, Nov., p. 59, by Walsh and Riley, and they recorded it as "so numerous at Franklin, N.Y., that almost every apple tree contains half a dozen nests." In 1870, Hartwell ('Am. Ent. and Bot.,' 5, No. 2, p. 336) reported it as 'unprecedently numerous' at Wilkinsonville, Mass., and Bethune[1] recorded its great abundance in Ontario, that year and the year following. In the *Canadian Entomologist*, Aug., 1871, Saunders refers to it as "a serious pest just now affecting the apple trees. It has found its way into Ontario from the Eastern States within a few years past and is rapidly spreading." The following year, Bethune gave a popular account of it in the same publication ('Can. Ent.,' 1872, p. 141-143) and stated that it was extremely abundant and destructive throughout Ontario and the neighboring northern and central States. Saunders[1] refers to the destruction wrought by the larvæ in 1873, but no further accounts of their ravages were published for some time, so this was probably the end of the outbreak.

Seven years later, Riley ('Am. Ent. and Bot.,' Vol. 3, pp. 22-23) published an account of the widespread destruction of black ash by this species in New York: and the following year, he notes ('Am. Nat.,' 15, pp. 747-748) the beginning of an outbreak in Washington, D.C. Claypole[2] reported its presence on walnuts in Pennsylvania in 1882, and Saunders[3] (Ontario) in 1884, said the caterpillars had been found in great abundance on all kinds of trees. In the *Canadian Entomologist*, 1886, p. 23, Jack records their abundance in Quebec during the past three or four years; and the following year Harrington says ('Ann. Rep. Ent. Soc. Ont.,' p. 29) they were "very abundant and obnoxious throughout Canada." Riley also records the larvæ as exceptionally prevalent in the Atlantic States in 1886, when they became such a nuisance in the City of Washington that thousands of dollars were spent in their eradication. He later records in 'Bull. 10, U. S. Div. of Ent.,' that they were scarce the following year, which indicates that the outbreak came to an end about 1887.

It was not long, however, until the insect was again on the increase, for in 1890 it was recorded by Bethune[4] as exceedingly abundant in all parts of Ontario; and by Harvey[5] as very injurious in Cumberland County, Maine. The following year, Bethune ('Ann. Rep. Ent. Soc. Ont.,' 1891, p. 14) said it was even more abundant than ever in Ontario, and in *Garden and Forest*, 1891, pp. 291-292, Robbins, in a popular account of the insect given under the title "A Struggle with the Webworm," refers to its extreme abundance in New York State. In 1892, it was referred to several times by Bethune and Fletcher, as one of the most serious pests of our orchard and shade trees and rapidly increasing in numbers. The following year, Harrington[6] reported it as very abundant in Ontario and the Maritime Provinces and "as one of our most noticeable pests." Fernald ('Bull. 20, Mass. Agr. Exp. Stn.,' 1893, pp. 10-12) stated that it was very abundant throughout Massachusetts. Smith[7] states that the insect was

[1]1870. Bethune, C. J. S., First Ann. Rep. Ent. Soc. Ont., p. 20.
[1]1873. Saunders, Wm., Ann. Rep. Ent. Soc. Ont., p. 13.
[2]1883. Claypole, E. W., Ann. Rep. Ent. Soc. Ont.
[3]1884. Saunders, Wm., Ann. Rep. Ent. Soc. Ont., p. 12.
[4]1890. Bethune, C. J. S., Ann. Rep. Ent. Soc. Ont., p. 7.
[5]1890. Harvey, F. L., Ann. Rep. Me. Agr. Exp. Sta.
[6]1893. Harrington, W. H., Ann. Rep. Ent. Soc. Ont., p. 27.
[7]1895. Smith, J. B., Ann. Rep. New Jersey, Exp. Stn., p. 386, 458-460.

decidedly on the increase in New Jersey in 1895, the outbreak being the worst in his experience. Howard also mentions it in the 'Year Book of the U. S. Dept. of Agr.,' 1895, pp. 361-381, and says that it did much damage in Washington, D.C., in 1895. In 1896 it was still fairly abundant in some localities for Dearness in the 'Ann. Rep. Ent. Soc. Ont.,' p. 24, says "I know of two localities where every black ash, of which there were a great many trees, was completely defoliated. Weed ('Bull. 59, N. H. Agr. Exp. Stn.,' Nov., 1898) also recorded the caterpillars as "extraordinarily abundant" in New Hampshire and as causing serious injury. An infestation occurred in Maine in 1899, and probably in New York as well, since Felt gave an account of the insect that year in the *Country Gentleman*, p. 593.

The insect does not seem to have attracted attention again until 1903, which marks the beginning of our latest outbreak. In the 'Ann. Rep. Ent. Soc. Ont.,' for that year, Fletcher records it as "noticeably on the increase of late." Two years later Lochhead[1] found it "unusually numerous" at Guelph although it was apparently still quite rare in some parts of the Province (Ontario). In 1906, Young[2] (Ottawa) says its conspicuous nests were noticed in many orchards and also in the forest. In the 'Annual Reports of the Entomological Society of Ontario' for 1908 and 1909, its great abundance was noted by Gibson and Lochhead, and in the 1910 Report, Gibson states (p. 13) "During my residence in Ottawa since 1899 I have never seen so much injury by this well known pest as was done this year. It has been abundant this year all through Eastern Canada and the United States." Gibson[3] again refers to it as being present in "unusually injurious numbers" in 1912. The next year the infestation began to decrease and in 1914 the insect practically disappeared. This last outbreak was by far the most widespread and severe of any which have been recorded.

Central Region.

The first record of the presence of the Fall Webworm in the Central Region is given by Walsh, in the *Practical Entomologist*, July, 1866, p. 101. In this, he states that this insect was reported by Marion Hobart as found on apple and other trees and more commonly on pignut-hickory in Illinois. The following year, he says (*Practical Entomologist*, March, 1877, 2, p. 72) that reports from Illinois indicate many nests on wild cherry the previous autumn. In 1868 Walsh and Riley ('Am. Ent.,' 1868, Nov., p. 59) record them as having "covered the hickory trees with webs" at Madison, Wisconsin. Three years later, in his 'Second Report of the Insects of Illinois,' p. 18, Walsh writes "The Fall webworm has heretofore not been regarded as holding more than a third rank in the catalogue of noxious insects but they seem to be on the increase this season." The same year, Riley states in his 'Third Report of the Insects of Missouri,' p. 130, that this insect was "unprecedently numerous all over the country during the summer and fall of 1870." Kridelbaugh[4] reports its ravages in Iowa during the same year.

The next available record of the insect was given by Osborn in the *Iowa State Leader*, Oct. 14th, 1882. Four years later, its ravages were reported in this region by Weed in the Prairie Farmer, July 24th, 1886, p. 409, and in 1888 MacMillan[5]

[1]1905. Lochhead, Wm., Ann. Rep. Ent. Soc. Ont., p. 137.
[2]1906. Young, C. H., Ann. Rep. Ent. Soc. Ont., p. 16.
[3]1912. Gibson, Arthur, Ann. Rep. Ent. Soc. Ont., p. 15.
[4]1871. Kridelbaugh, S. H., Ann. Rep. Iowa State Hort. Soc., pp. 153-167.
[5]1888. MacMillan, Conway, Bull. Agr. Exp. Stn., Neb., Feb. 1888, pp. 64-68 and 96-100.

records it as a common insect of Nebraska. Its great abundance in Missouri the same year, was noted by Mary E. Murtfeldt in the 'Ann. Rep. Ent. Soc. Ont.,' 1892, pp. 58-59. Garman noted its "excessive ravages in Kentucky" in 1890, but says that fifty per cent. of the larvæ were killed by a fungus disease, so this was presumably nearing the end of the outbreak.

There was probably another outbreak between 1895 and 1898, but the following references, seeming to indicate this outbreak, were not available to the writer. H. E. Weed gave an account of the Fall Webworm in the *Southern Cultivator*, Sept., 1895. Webster published some notes on several species of injurious insects including the Fall Webworm in the *Ohio Farmer*, May 30th, 1895. In the *Kansas Farmer*, June 29th, 1899, pp. 438-439, the Fall Webworm among other insects, was treated by E. A. Popenoe. The same account was also given in the "Transactions of the Horticultural Society of Kansas," 1898.

In 1906 the insect was reported as very abundant in Ohio by Berger,[1] and two years later Smith of the Nebraska Division of Entomology (Circ. No. 5) records its depredations on shade trees of towns and cities all over the State. Its ravages were reported in the same year from Minnesota by Washburn ('Minn. Agr. Exp. Stn. Bull.,' 112, pp. 180-183). This is the latest outbreak recorded from the Central Region, and although it seems to have been very severe but little information concerning it is available.

Western Region.

Our information concerning this insect in the Western Region is very meagre. The first record of its presence is given by Bethune in the 'Ann. Rep. of the Ent. Soc. Ont.,' 1887, p. 58. Here he states that "last autumn (1886) Professor Saunders observed it defoliating trees in British Columbia." The next reference found is in the 'Fourth Ann. Rep. of the Hort. Soc. of B.C.,' where it is referred to as "very destructive" around Chilliwack in 1893. It is also referred to in the 'Fifth Report' of the above society, and the following year Piper stated ('Bull. 17, Wash. Agr. Exp. Stn.') that it was common all over the State of Washington.

In the 'Report of the Experimental Farms,' 1903, Fletcher states that "The webs of this Arctiid were very conspicuous in British Columbia" that season, which would indicate another outbreak of the insect at about that time.

The next reference to it is by Brittain in 1912 ('Proc. B. C. Ent. Soc.,' p. 15) when he noted the "abundance of the webs on apple and wild shrubs" in British Columbia. This was no doubt the beginning of the present outbreak which attracted so much attention last year.

MR. WINN: Is any record being kept of any particular locality, such as Fredericton, without going so many miles away for a record? Are you attempting to keep any record of your own individual locality of either of these insects.

MR. BAIRD: Yes, we have a fairly complete record of the different localities in New Brunswick.

MR. WINN: About five years ago I wanted to get the eggs of the Forest Tent Caterpillar to send to a friend in Yorkshire, England, and I could not get the eggs for love nor money. Prof. Swaine, however, very kindly procured some eggs for me; these were from Nova Scotia and were extraordinarily abundant. It shows that in certain localities there is a great abundance while there are none

[1] 1906. Berger, E. W. Bull. U.S. Bur. of Ent., No. 60, pp. 41-51.

in other parts. During this past year you may say both the American and the Forest Tent Caterpillars have become extinct on Montreal Island, while at St. Hilaire, Que., only 22 miles east, on the 24th of May this year there were thousands of caterpillars in a space as large as this room; I should think without exaggeration there were 500 *americana* webs there. A fungus disease killed off both insects apparently and not only killed off the Tent Caterpillar, but a very large number of other caterpillars as well. We don't know when they are coming back, and if any record could be kept of the number of years between certain outbreaks we might know when the next infestation or migration or whatever it may have been is likely to occur so that we could prepare for them. Fruitgrowers would no doubt like to know ahead of time so that they could head them off.

Dr. Hewitt: In reference to your enquiry as to whether any definite record is being kept, this is work of which Mr. Tothill has charge primarily. He has charge of the investigations on the natural control measures of three of our most common deciduous pests, viz.: Forest Tent Caterpillar, Fall Webworm and Spruce Budworm. Our idea in carrying on these investigations—which have already covered a period of four years—is to study all those factors which go to control these pests. For that purpose we have established in the Province of New Brunswick nine different points at which observations have been made every year at least for the last three years and in some cases for four years, so that we have exact records of what has taken place in regard to abundance, parasites and other means of natural control. In addition to that we are now undertaking investigations to cover the whole of Canada so far as we can. Next year Mr. Tothill will probably be in the West making observations on the occurrence and, so far as he can, the natural means of control of some of these insects, particularly the Fall Webworm and the Western Forest Tent Caterpillar in the Prairie Provinces and in British Columbia, our idea being to secure as thorough a knowledge as we can of the factors which go to control these insects under natural conditions. We have been rather prone to attribute everything to insect parasites; that has been in some cases an assumption not based on sufficient evidence and already very interesting results have come out, but of course, as I have said, we are undertaking to carry on these investigations for a number of years.

I have not had time to discuss this paper with Mr. Baird yet but there is one point which seems to me of interest and importance. You will notice from his charts that there is a certain amount of regularity in regard to the outbreaks in what I would call the historical period which goes back to about the middle of last century but if we call the period before that the pre-historic period so far as exact observations by entomologists are concerned I think we can explain the nature of the evidence of that period. I feel rather inclined to attribute the apparent local restriction of the ravages as Mr. Baird has termed them in his charts of the Fall Webworm and the Forest Tent Caterpillar not so much to the fact that they were actually local but to the fact that the observations did not extend over a large area. Consequently the records of abundance were confined to certain localities.

Prof. Lochhead: These charts are very interesting to me and I think the study is very timely. The charts reveal a great deal, it seems to me. There is one thing that stands out and which impresses me very much, a point which applies to the Forest Tent Caterpillar as well as the Fall Webworm. It

seems that the chief factor in the limitation of these pests is that the parasites are apparently everywhere at the same time and that the outbreaks occur in the same years almost throughout the three different regions. It looked that way to me when looking at those charts just now.

Dr. Hewitt: I do not think they quite coincide, *e.g.*, the 1870 and 1880 outbreaks.

Prof. Lochhead: Outbreaks are coincident, and the parasites must have developed in the different regions at the same time and in greatly increasing numbers. That would seem to eliminate any method of control—for example, the distribution of parasites that would tend to prevent the outbreaks. In the Northern Forest Districts between those of the Central or Western at different times it might be possible, if we had better resources at our hand, to carry parasites from one district to the other.

Dr. Bethune: I might mention one instance of very exceptional natural control in connection with the American Tent Caterpillar. It was about 25 years ago when at Port Hope we had a steadily increasing abundance of these insects from year to year; they were extremely numerous. In this particular spring the caterpillars had emerged from their cocoons when the apple buds were just opening and we had a very severe frost that killed them all; we saw no more of those tent caterpillars for three or four years. Of course that would be a very exceptional case.

Mr. Harrington: In reference to the tent caterpillar I may say that the first time I was in British Columbia, that is about 1888, there was a serious infestation then in the district around Victoria. Parasites were lessening the ravages. That would correspond apparently with the first outbreak that is on that chart of the Western Region in 1888. The infestation was very heavy. With regard to more recent infestations which we have had in this eastern section of the country, of course three or four years ago the ravages were very serious in certain districts of Quebec Province. Some species of trees, poplars, etc., were almost totally defoliated for two or three years and the caterpillars were so numerous as to stop the trains. I know this is a fact, because I was on a train which was stopped by caterpillars on the track. That infestation has been checked now, and I think principally by the tachina flies as the infestation reached its maximum. There is no doubt, I think, that the caterpillars were almost entirely wiped out by these tachinids although last year there were, of course, webs to be seen in the same district. They build almost entirely on the wild cherries which are the natural habitat of the caterpillar under ordinary conditions. They seldom spread to other trees until the infestation increases towards the maximum, and that appears to be about every ten years, as far as my recollection goes, of the occurrences which I have seen in thirty or forty years. Sometimes, of course, caterpillars are subject to a fungus disease but the reduction of the numbers I think is chiefly due to our good friends, the tachinids.

Prof. Caesar: I wonder if Mr. Harrington has reared those tachinids.

Mr. Harrington: I did a good many years ago.

Prof. Caesar: The reason I ask is because I collected quite a number of Forest Tent Caterpillar cocoons and reared the parasites from them, and they were all *Sarcophaga aldrichia*, a new species described two years ago. I do not mean that those Mr. Harrington saw were not tachinids, but all I reared were sarcophagids.

Mr. Gibson: We collected a large number of the cocoons and I remember distinctly sending a lot to Mr. Tothill who failed to report on them.

Mr. Baird: I do not think anything was ever reared from those: they were in poor condition when they arrived as they were a long time in reaching the laboratory.

Prof. Caesar: I merely mention this matter because it is possible we are not doing justice to the sarcophagid flies.

Dr. Hewitt: I think Mr. Tothill has raised both tachinids and sarcophagids.

FRIDAY AFTERNOON.

Mr. Winn: The programme is a very lengthy one and this year I think it would again be advisable to dispense with the Presidential address. As practically all matters connected with our season's work have been covered by our various reports the address would be either largely repetition or else be merely a paper and I have already read one. Before the programme was completed and found to require all the available time, I thought of two subjects that might be of interest. One was to show a series of slides that I had begun preparing with Mr. H. M. Simms of our Montreal Branch, calling attention to the very curious microscopic objects known in Europe as "battledore" scales or "bladder-scales" of the Blue butterflies. These are found on the wings of the males only and are much smaller than the regular wing scales and apparently each species has its own characteristic size, shape and pattern of "battledore." We have not succeeded in obtaining specimens of quite all the North American so-called species, but with the kind assistance promised it is hoped that by the time Mr. Simms returns from "somewhere in France" we may have an almost complete series to show.

The other idea that occurred to me was in connection with the Society having spread from a centre which was originally Toronto, then London, now Guelph, always in Ontario, to a national Society extending from the Atlantic to the Pacific. We have branches in Nova Scotia (represented by Prof. Brittain) the Montreal Branch, Toronto Branch and the parent Society in Guelph, individual members scattered through all the Provinces and a very flourishing Branch in British Columbia. I thought the annual address might take the form of a composite article by all the different branches regarding the insect collections of the Dominion of Canada. I have spoken to Dr. Walker and he thinks this can be arranged by a series of articles published in the *Canadian Entomologist* as part of the popular series now being printed. It would be impossible to read such a report at a meeting like this; I leave it for your consideration, and if found feasible, your co-operation.

CAMP HYGIENE.

Capt. G. J. Spencer, O.A.C., Guelph.

The main object of military hygiene is to keep men healthy, or else they cannot march. In camp certain factors control this, such as food, work, exercise and the condition of the body. As far as food is concerned, a Canadian soldier is fed more generously than one of any other nationality, as he is allowed five pounds of food a day. Beef constitutes the invariable meat ration, because it can be more easily obtained, is cheaper, and is more preferable to the men; potatoes, peas, beans,

carrots and cabbages, are the standard vegetables; coffee and tea are supplied at breakfast and supper. Meals are drawn up a week ahead on a diet sheet, and it lies with the Quartermaster of each battalion to vary this, and to make the meals as appetizing as possible. The men are generally allowed to have as much as they can eat. Extras of food such as pie, cookies and fruit in season, are supplied when canteen funds permit.

I need not say anything about work. Exercise is supplied by a carefully arranged syllabus of physical training and bayonet-fighting, on a system calculated to stretch all the muscles of the body, and to produce speed and quickness, rather than over-developed, hard muscles. No apparatus is employed. The bayonet-fighting is a combination of the British and French systems, and was made up to meet the exigencies of trench warfare. Men are taught to kill their opponent, or to put him out of action in any way possible without any "gentlemanliness" or rules of fair fighting. Boxing, which is much akin to bayonet work, and games of skill, are always taught and encouraged.

To insure immunity against typhoid and smallpox, every officer and man is inoculated and vaccinated.

Life in a training camp, as far as it concerned Camp Borden, was intended to fit for the front, as far as could be done in this country, men who were already hardened to military life, and had already received their preliminary training. The general health of the camp was excellent. The problem of sanitation was reduced to a minimum on account of an extensive and excellent system of plumbing, which provided almost hotel conveniences. Strict rules were made against throwing rubbish around or committing a nuisance anywhere in the camp area, and because the wash houses were at one end of every battalion area, tubs were placed in each company line for the convenience of the men at night. These were removed the first thing in the morning. The men slept in bell tents, 8 to 10 men in a tent, and the notorious Camp Borden sand was soft to lie on, until wooden tent floors were brought from Niagara Camp for some of the battalions.

What with the open air life, the work and exercise, the freedom from city evils and an abundant supply of the purest water for drinking and shower baths, the health of the men was excellent, and their physical condition greatly improved through the summer.

As far as Entomology is concerned, I know of only three cases of lice in our battalion all the summer, one of head and two of body lice. The treatment was one of prevention, but where a case of infestation occurred, the subject was at once taken to medical headquarters and given a prolonged hot bath, while his clothes, blankets and kit, and that of all the other men in his tent, were passed through carbolized steam under pressure for half an hour, and were ready for him after the bath. This treatment worked admirably, and no second application was necessary. The carbolized steam installation was used to sterilize the blankets of the camp, and could treat those of a battalion, *i.e.*, about 4,000, in a day. This was done once a month, for each battalion. A system of the same kind is being installed at the headquarters of each military district and it is proposed to periodically treat the blankets of the battalions in winter quarters.

House flies were a nuisance and increased rapidly throughout the summer. The five cook-houses of each battalion were wire screened and provided with spring wire doors, but flies were troublesome in the men's tents. With regard to our brigade, I could not account for the pest of flies, because the most stringent rules were enforced about garbage and refuse of all kinds. Special bins were provided for all waste matter and horse manure, and were emptied daily by a Government con-

tractor, who carted it away. Fatigue parties picked up all rubbish twice daily, and later in the summer, sheet iron incinerators were provided, that burnt all garbage, waste paper, horse manure and camp sweepings. And still the flies increased! If all the brigade areas were as well kept as was our own, I am at a loss to explain the pest of house flies, as I could not discover any breeding places. In the Quartermaster's stores, the Canteen, the Hospital and some of the office tents, the men used Jeyes' fluid, which was issued from the stores, in the proportion of one half to one pint per pail of water, for spraying around on tent walls and furniture. This was fairly effective as a preventive, and I showed some of the orderlies how to make nets from wire and cheese cloth, which they used all the rest of the summer, taking keen interest in fly hunts for competition.

One other point of Entomological interest occurred this summer. A private in my company, formerly a High School student and a boy of clean habits, was admitted to the Base Hospital in Toronto for an abdominal operation. When he got to Toronto he suffered with slight earache, and two days after admittance this increased to intense pain, and he found newly hatched maggots crawling in his ear. He promptly reported it to the doctor, who ordered irrigations of boracic acid, followed by alcohol and bichloride, 1 to 8,000. After three days of this treatment, all trouble ceased. To my disappointment, I found that neither patient nor doctor had preserved any of the maggots, and they were not identified.

In conclusion, hygiene on the march is much as I have outlined it for camp. Meals cook in travelling field-kitchens as the wagons follow the column. The water supply is inspected by the Medical Officer, who rides on ahead with a Field Officer, to select a site for the camp. As soon as a force halts, temporary latrines are dug as far away from the kitchens as possible, and after use are covered in and marked with the letter "L" in stones or sods, as a warning for troops following on behind.

THE EXPERIMENTAL RESULTS IN APPLE MAGGOT CONTROL.

PROF. W. H. BRITTAIN, TRURO, N. S.

The work of our department with the apple maggot began in 1913, when an inspector, sent to investigate a report of this pest near Digby, uncovered a severe infestation in that locality. One of the worst infested orchards was selected for experimental purposes the next season.

The work for the next two seasons was conducted by my assistant, Mr. C. A. Good, who has given a full account of his work in the Report of the N. S. Entomological Society for 1915.

In the first year of our work, the mistake was made of spraying only a portion of the orchard, leaving the rest as a check on our work. There was, it is true, a decided advantage of the sprayed over the unsprayed portion, the former showing an infestation of 12 per cent. in the fruit of all varieties, and the latter of 44.7 per cent. We also sprayed isolated trees in infested orchards, getting no reduction in injury, one such tree showing an infestation of 99 per cent. From this it was evident to us that it was useless to spray only a portion of the orchard, on account of re-infestation of sprayed trees from neighboring unsprayed ones.

In the meantime our inspectors had uncovered another severe outbreak of this pest in the neighborhood of Windsor. Both the Digby and Windsor districts, one situated on the west, the other on the east of the main fruit belt, afford

exceptional facilities for spraying work with this pest. The orchards are small and isolated, and a number of them suffer from very severe outbreaks of the maggot. This gave us an opportunity of thoroughly testing the use of the sweetened poison in this locality, since it was an easy matter for us to secure suitable orchards for spraying, and take neighboring ones for use as check orchards. Five orchards were accordingly selected in each district, three being treated twice with arsenate of lead and molasses, and two left as checks. In checking up the results of our work we counted, as nearly as possible, all the fruit from the experimental trees, a total of 260,000 in 1915.

The results of this work having already been published, it is unnecessary for me to refer to them in detail, except to say that they were a striking success, though the season was a very wet one. Orchards in which the fruit of susceptible varieties had been a total loss for a number of years past, gave us fruit that was 95 per cent. free from infection.

A number of experiments were conducted during the season with flies confined in cages over apple seedlings, which were sprayed with various poisons, both with and without molasses. The results showed the interesting fact that, under these conditions molasses was of no particular benefit. Though these conditions were not by any means normal for the flies, this experiment suggested the possibility that the molasses might be eliminated without lowering the efficiency of the spray.

Next season additional orchards were chosen, making altogether three sprayed and two check orchards at Windsor, and six sprayed and two unsprayed at Digby. Three arsenicals, viz: lead arsenate, calcium arsenate and barium arsenate, were used, both with and without molasses. Briefly summarized the results were, that all these sprays effectively controlled the maggot, and that there was no noticeable advantage in those containing the molasses.

This fact that we have thus demonstrated experimentally is substantiated by much indirect evidence. The most significant fact brought out by our inspection is that both the badly infested districts are outside the main fruit belt, where spraying has never been practised. As soon as we get into the well sprayed parts of Kings and Annapolis, the pest begins to disappear. In spite of this, we have been able to find the pest in the haws at various points throughout the Annapolis Valley. In one such locality I have been informed that years ago there were severe infestations of this pest in the orchards of the district, but that with the advent of arsenical sprays it gradually disappeared. A very careful search also revealed the presence of the insect in apples at widely separated points. Inquiry here also elicited the information that formerly the pest was much worse in such localities, but finally died out as spraying became general.

There can thus be little doubt from the evidence on hand, that sprays of arsenicals alone will control the apple maggot, and that the arsenical residues from the sprays ordinarily applied in the orchard are usually sufficient to keep it in check.

Prof. Caesar: I have listened with a great deal of interest and pleasure to Prof. Brittain's paper, especially as his results corroborate so fully those secured by Mr. Ross and myself during the last four years. Our first tests with sweetened arsenate of lead as a means of control for the insect were on undivided trees or groups of trees in an orchard instead of on the whole orchard, because at that time we believed, along with most other entomologists, that this insect did not fly much from one tree to another, but remained close to the same tree through its life. Our results showed that if this were true, spraying with sweetened arsenate of lead was quite

unsatisfactory as a control measure. Fortunately that same year I was studying the very closely related two species of Cherry Fruit-flies, and found in the course of my work proof that these moved around freely from tree to tree, though we should not have suspected it to watch them. This discovery along with the excellent results obtained against the Cherry Fruit-flies by the use of arsenate of lead and molasses, led us to hope that by spraying a whole orchard at a time, or at least very large blocks of trees, the same good results from the poison on the Apple Maggot might be obtained as had been so easily obtained against the Cherry Fruit-flies. Acting on this hope we conducted a series of spraying experiments with sweetened arsenate of lead in 1914, 1915 and 1916, and as a result of these experiments both of us were thoroughly convinced that arsenate of lead and molasses was a simple and satisfactory means of control. We did not try, except in cage experiments, arsenate of lead, or any other poison alone, simply because we found it difficult to discover a sufficient number of orchards in which to make satisfactory and separate tests of more than the one remedy. We plan next year to make such tests, and also some others that we have been working on this year in a small way in cages, and that seem to promise well.

As to the length of time it takes arsenate of lead to kill the adult, I cannot recall the results Messrs. Ross and Good obtained, but this year I conducted a series of cage experiments begun shortly after the flies began to emerge, and continued until they disappeared from the orchard. These showed that flies caught in the orchard without injuring them and put into cages with poisoned and unpoisoned leaves and fruit in the same cage and watered daily, died on an average in less than three days, whereas the check flies lived a much longer time. Moreover, there is good reason to believe that even though an orchard is not sprayed until a number of flies are ready to lay eggs, the poison acts in such a way as to stop egg laying almost at once after it is eaten by the fly, even though she herself may live a few days longer before death ensues.

As to the sweetened poison attracting flies from some distance, I have never been able to see the least proof that this was true either of the Cherry Fruit-flies or of the Apple Maggot. They merely eat it if it happens to be on the leaf or fruit where they are feeding; they do not go in search of it.

EXPERIMENTS ON THE CONTROL OF LOCUSTS WITH COCCOBACILLUS ACRIDIORUM D'HERELLE.

E. Melville DuPorte and J. Vanderleck, Macdonald College, Que.

Since 1910, when d'Herelle isolated from diseased locusts in Mexico a bacterial organism causing an epidemic disease in these insects, efforts have been made in various parts of the world to utilize this organism in the destruction of locusts. D'Herelle himself in the year following his investigations in Mexico, conducted experiments in the Province of Santa Fé in Argentina, and reported remarkable success.

Sergent and l'Heritier, working in Algeria in 1913, did not have an unqualified success in their attempts to disseminate this disease, for while they were able to collect dead locusts by hundreds in the areas which they had infected, they found that the size of the swarms was not appreciably diminished. They attributed their failure to three contingencies. Either the infection did not spread through the majority of the migrating swarms, or many of the locusts possessed a natural immunity, or else they easily acquired an active immunity against the organism.

As a result of his work in South Africa Lounsbury, in 1913, came to the conclusion that in this country the method of d'Herelle can be used only as a supplementary measure, and that only under certain conditions. It cannot be used as a substitute for arsenical poisoning.

Further work in Algeria, in Tunisia and in Morocco, has demonstrated that this method can bring about a considerable reduction in the size of the swarms of the migratory locusts which invade these countries. In each case it was found possible to create an epizootic centre by placing a few diseased locusts among the healthy ones.

In the summer of this year (1916) at the request of Dr. Hewitt, the Dominion Entomologist, we conducted experiments at Macdonald College, to determine whether d'Herelle's infection method could be effectively used in combating the locusts of Eastern Canada.

Increasing the Virulence of the Organism. D'Herelle found that when kept for some time in artificial culture the organism gradually loses its virulence, but that the virulence could be progressively increased by passing the organism successively through a series of locusts. The culture sent us by Dr. Hewitt was obtained by him from d'Herelle, and was consequently quite old when our work was commenced. In order to obtain an active culture, and to have this on hand for daily use, we inoculated several locusts each day with a suspension of the intestinal contents of one of the locusts dead from the previous day's inoculation.

The first lot of nymphs was inoculated directly with d'Herelle's pure culture. At the end of twenty-four hours thirty-three per cent. were dead, and at the end of forty-eight hours fifty per cent. In five days all of the inoculated locusts had succumbed to the disease. Plates poured from the intestines of the dead locusts gave a pure culture of *Coccobacillus acridiorum*. One of the locusts which had died during the first twenty-four hours was carefully opened with sterilized instruments and a suspension of a portion of its intestinal contents made in sterilized water. This suspension was used to inoculate the second lot of locusts. This second lot died slowly, only 83 per cent. having perished at the end of five days. The third and fourth lots showed an increase in the virulence of the organism, but in each case there were three insects surviving after twenty-three days. Of the sixth lot sixty per cent. were dead at the end of twenty-one hours and the remaining forty per cent. at the end of thirty-four hours. Sixty-four per cent. of the seventh lot died in twenty-two hours, and the remainder were all dead within thirty hours from the time of inoculation. After this the virulence of the organism progressively increased; no locusts survived, the deaths occurring in four to twelve hours. Thus our experience in increasing the virulence of the organism coincides with that of other workers.

Insects Affected by the Disease. The pathogenicity of the organism was tested for all species of locusts and grasshoppers commonly occurring in this region. These were *Melanoplus femur-rubrum*, *M. bivittatus*, *M. atlanis*, *Dissosteira carolina*, *Camnula pellucida*, *Stenobothrus curtipennis* and *Xiphidium* sp. The coccobacillus proved to be pathogenic to all these species. It gave us considerable satisfaction to observe that the animal parasites were apparently not affected by the disease. Innumerable individuals of *Gordius* emerged alive from inoculated locusts, and we were able also to rear several adult *Sarcophagids* from these diseased insects.

An Indigenous Organism. On August 16th, before any experiments were started outdoors, a dying *bivittatus* was found about a quarter of a mile away

from the laboratory. The intestines were decayed into a black mass resembling that of insects killed by *C. acridiorum*, but not quite so slimy. Agar plates were made from the contents of the intestines and a practically pure culture of a bacillus closely resembling that under study was obtained. Twenty locusts were inoculated with this organism, and all but one died within forty-eight hours. From these dead locusts a series of successive inoculations was made to determine whether the organism would increase in virulence similarly to *C. acridiorum*. We found that this was the case; the later ones in the series dying very much sooner than the earlier ones.

A very large number of other locusts, healthy, sickly or dead were collected on Montreal Island, and other islands in the Ottawa as well as on the mainland along the north shore of the Ottawa. In almost every case this organism was found in the intestines. We are at present making a study of it to determine whether it belongs to the same group as *Coccobacillus acridiorum*.

Experiments in the Laboratory.

In order to become acquainted with the nature of the disease before working with it in the field, we conducted numerous experiments in the laboratory, the results of which are here briefly summarized.

Several locusts were sprayed with a suspension of the coccobacillus, and put into a sterilized cage. At the end of eight days fifty per cent. of these were dead. The others remained alive for several days after when their death could not with certainty be attributed to the organism, because several of the dead locusts were parasitized, and it was often difficult to tell whether death was due to the disease or to animal parasites; it must therefore be borne in mind that an appreciable proportion of the deaths recorded in this and other experiments was probably due to parasites.

Experiments were tried to determine whether the disease would spread rapidly from dead or diseased locusts to healthy ones. To this end a number of healthy insects were placed in cages with dead ones. The species used was largely *M. femur-rubrum* with a few individuals of other species. A very low mortality was obtained. It was observed, however, that occasionally a *bivittatus* would feed on the dead insects, and in order to determine the effect of this habit on the spread of infection *M. bivittatus* and *M. femur-rubrum* were placed in equal numbers in a cage with fragments of dead locusts. At the end of eight days eighty per cent. of *bivittatus* were dead, and only twenty per cent. *femur-rubrum*. In this connection it may be stated that in the cases in which investigators have obtained successful results in the artificial dissemination of *Coccobacillus acridiorum* the locusts experimented upon showed marked cannibalistic tendencies, the healthy ones devouring the sick and dead.

Placing healthy locusts in unsterilized cages in which diseased locusts had been confined and had died but a few hours previously caused no disease or death.

A number of locusts were fed with a bran mash to which a suspension of *C. acridiorum* had been added. At the end of seven days fifty per cent. were dead, four days later the mortality had reached seventy-five per cent. The remainder were removed to a clean cage, and eight days after their removal were all dead. It is thus evident that ingestion of the organism will produce disease and death.

Field Experiments.

An attempt was made to establish an epizootic centre in a field of clover badly infested with *M. femur-rubrum*, and to a lesser extent with most of the other species used in the laboratory. A small area of this field was treated with bran mash, to which a culture of the organism had been added. The field was examined carefully for several days, but no evidence of the establishment of an epidemic among the locusts could be obtained. A large number of locusts was collected from the infected area and placed in cages in the laboratory, but the disease failed to develop among them. The experiment was repeated on a badly infested lawn with a similar result.

In order to check results more definitely outdoors, a small area of a lawn was enclosed with a wire screen, and a large number of locusts included. First of all the enclosed area was sprayed with a bouillon culture of the coccobacillus. At the end of a week there were no deaths. The failure of this experiment may have been partially due to the death of the organism, as a result of its exposure to bright sunlight.

The wire cage was next moved to a new locality and bran mash sprinkled on the grass. From this a high mortality was obtained.

Twenty locusts inoculated with a virulent culture of the organism were next introduced among the healthy locusts in a new enclosed area. The cage was examined every day, and at the end of the fifth day there were only thirty-nine dead, including the twenty inoculated individuals. The experiment was continued for several days, but no further deaths were observed.

Conclusion.

The foregoing investigations point to the conclusion that the infection method of d'Herelle for the control of locusts is not practicable in Eastern Canada, because of the probable immunising effect of a native bacillus, and also because the principal means of the natural dissemination of the organism seems to be the eating of the dead or diseased locusts by the healthy ones, a cannibalistic tendency which exists only in a very slight degree in our native species.

There may, however, be conditions under which this method may prove effective, so that we hesitate to say definitely after only one year's work, that it can have no place in control methods in Eastern Canada.

Dr. Hewitt: Perhaps if I were to explain the genesis of this work it might facilitate discussion afterwards. I have been in correspondence with Dr. d'Herelle for some years, and in 1913 obtained specimens of his culture from him, and had one of our officers, Mr. Petch, work with it that year, and the two following years, and we found that *C. acridiorum* was pathogenic to our native species, especially the species which are most abundant. In 1914, we carried out our first field experiments in control, but the climatic conditions were such that we did not feel justified in placing any definite conclusions. In 1915 the conditions were more favorable, and we used the bouillon exactly as d'Herelle had instructed in his letters to me, as well as in his papers, but we were unable in that year with every condition favorable to find that it could be used in Eastern Canada at least in the Province of Quebec, where these experiments were tried.

As I knew that the authors of the paper just read were studying the micro-organisms affecting insects, I took the matter up with Dr. Harrison, and suggested that they carry on these experiments with *C. acridiorum* still further, because I

realized that the combination effects of a bacteriologist and entomologist were required. As I had no bacteriologist on our staff, I thought this a favorable opportunity, and I am very pleased to find that the conclusions of one season's work confirm the conclusions that we had come to as a result of our experiments.

I think the suggestions they make in regard to the reasons for the lack of success, viz: that in the first place we may have comparative immunity among some of our species of grasshoppers owing to the presence of a specific Coccobacillus of our own, and secondly the absence of any cannibalistic habit are the most probable. To get the cannibalistic habit in the pronounced degree that you would require to obtain success in your experiments you would have to have enormous number of locusts. I think the two reasons advanced will probably prove to be the cause of the inability to use this Coccobacillus in Canada, and it certainly cannot be recommended at the present time.

SOME FEATURES OF INTEREST IN CONNECTION WITH OUR STUDIES OF FOREST AND SHADE TREE INSECTS.

J. M. Swaine, Entomological Branch, Department of Agriculture, Ottawa.

This season, as usual, British Columbia furnished many interesting forest insect problems, though but two are mentioned here. The work with the Western Cedar Borer, a species of *Trachykele*, has afforded us valuable information upon the life history and habits of the beetle, and especially upon the districts at present affected, and the types of trees most subject to attack. There is apparently little hope of obtaining an effective control for an insect that breeds freely in the heartwood of living forest trees, but we expect to materially assist the lumbermen in avoiding loss from its work. It is interesting that while the borers do occur in apparently normal healthy cedars their work is usually found in dead top cedars upon the ridges. It is evident that burning the slash from infested trees, before the early spring, will materially reduce the numbers of beetles in the limit, and that the infested timber should be utilized, so far as practicable, for such purposes as it is still suitable.

The bark beetle outbreaks in the yellow pine and black pine of Southern British Columbia have been spreading rapidly until the present season. In some of the valleys, where three years ago the outbreak was evidenced by clumps of red-tops here and there, numbering each from five to about fifty trees, the injury is reported now as beyond any reasonable hope of control. However, an interesting condition has apparently arisen in at least the western portion of the infested area, where our reports would indicate that some influence other than parasites has succeeded in at least temporarily checking the spread of the beetle. Mr. Chrystal examined the infested valleys of the Nicola region, and is satisfied that there has been little extension of the infestation this summer. The cause of this check is not yet apparent, but it is worth noting in this connection that the summer and winter of 1915 afforded most unusual weather conditions in the area concerned. The summer of 1915 had an extremely heavy rainfall over this normally dry country, and the following winter will be long remembered throughout Southern British Columbia for its extreme cold. In the spring of 1916, wide definite belts of timber well up on the mountain sides were turning yellow and were apparently killed, in the Nicola country, as well as at other places, such as Field, B.C. The explanation appears

to be that the unusually wet weather had resulted in excessive tree growth for the season with much unripened wood at the time winter set in. This could be expected to obtain to a fairly definite altitude well up the mountain sides. The excessive cold acting upon this unripened wood could be expected to cause considerable injury as far down the mountain sides as a sufficiently low temperature obtained. Much of this timber that appeared seriously injured or killed has in large part recovered. It is possible that a combination of weather conditions that has so seriously affected the timber, may have been affective in checking the development of the Dendroctonus beetles. Next summer's work in this region should afford much interesting information.

The Willow Leaf Beetle (*Galerucella decora*) on the Prairies.

The Canadian Prairie Provinces were visited this summer by most extraordinary flights of the Willow Leaf Beetle, *Galerucella decora*. The beetles were very numerous and injurious from Alberta to Southern Manitoba, and in many localities they appeared in immense flights, defoliating the shade trees with extraordinary rapidity, and attacking a variety of foliage. Under normal conditions this species breeds chiefly upon the willows, but feeds also upon poplars, and can be effectively controlled by poison sprays. When the great flights occur, however, unusual control measures must be employed, and without loss of a moment's time. If the facilities for the spraying are ready for immediate use, applications of strong kerosene emulsion to the beetles swarming upon the trees will prevent serious defoliation, and some of our correspondents were able to save their most valuable trees by smudges made of horse manure and litter, and kept burning until the flight of the beetles was over.

Pine and Spruce Borers.

Throughout the history of lumbering in Eastern Canada, there has been, each season, more or less serious loss from boring grubs in pine and spruce logs left in the woods unprotected over one or two summers. Special studies of these injuries and of the most practical methods of averting them under varying conditions, recently undertaken, have supported the recommendations that we have been making to our correspondents. Without going into the details of the experiments the results may be briefly given. The injury to white and red pine logs in our forests is caused by grubs of *Monohammus notatus* and *M. scutellatus*, the injury to spruce logs largely by *M. scutellatus*. *M. marmorator* has been bred by me only from balsam fir, and this species is in any case too rare in most localities to be of economic importance.

Floating the Logs. Logs of pine and spruce which must be left in the limits over a season should, if possible, be placed in water as soon as the ice is gone. If the logs are placed in a loose boom so that there is considerable drift, and therefore the top side of the logs is frequently wet there is rarely any serious injury, but an additional safeguard is employed in turning the logs about one month after they have been floated. I have not known logs handled in this way to be seriously injured by borers. If, as rarely occurs, the logs must be made into a close boom, so that there is little or no wave play over the top side of the logs, the turning should not be omitted, and particular attention should be paid to any so-called "yellow pine" sticks, since these float particularly high out of the water.

BARKING THE LOGS. If the cut, or any part of it, must be left over summer in the woods, such logs can be completely protected by barking them before the middle of July. The beetles will not lay their eggs upon bare wood, and the young grubs feed for nearly a month on the inner bark and sap-wood before boring in below the wood-surface.

COVERING LOGS WITH BRUSH. If barking the logs is considered too expensive, or must be discarded for lack of labor, we believe that the logs can be quite as completely protected by covering them densely with brush before the men leave the woods, or at least before June 1st. The logs should, of course, be piled on skidways, and should receive a very thick and complete covering of green spruce, pine or balsam boughs. The spruce brush makes the densest shade, and should, therefore, be used when it is easily available. The beetles love the sunlight, and will not enter the dense shade to deposit their eggs in the bark.

Other methods employed in our tests, and recommended by certain lumbermen, gave a varying amount of protection, but none of them for either cheapness of operation or effectiveness in protection could be compared favorably with covering with brush. For instance, crib-piling the logs in the open does not in our experience protect effectively the under side of large pine logs, since the under side is only moderately shaded and not effectively dried; spruce logs are, apparently, fairly well protected by crib-piling, probably because the bark is thinner and dries more rapidly.

THE IMPORTED ALDER LEAF-MINER, *Kaliosyphinga dohrnii.*

This interesting species has been recorded in American literature several times, apparently under different names. Professor Slingerland's specimens, bred from European alder at Ithaca, N. Y., were determined by Konow as *dohrnii*. Dr. Fletcher referred to the species found in European alder at Ottawa as *Fenusa melanopoda*. Mr. Harrington refers to the same species under *Fenusa varipes* St. Farq. (melanopoda Cam.), and Dyer describes the larva of the "Imported Alder Leaf-miner" under *Fenusa varipes* St. F.

The imported alders in the Arboretum at the Experimental Farm, Ottawa, have been attacked by the leaf-miner for many years. Dr. Fletcher stated in 1891 that it had been injurious for the three preceding years to the imported alders in the Arboretum; and in 1893 Mr. Harrington recorded it from native alders in that neighborhood. For the last four summers several species of these imported alders have been very heavily infested so that their beauty has been very largely destroyed. This season spraying was commenced, and the numbers of the insects greatly reduced. A species, probably the same, has been abundant for several seasons in native alders in a swamp about three-quarters of a mile from the Arboretum, so that, as Mr. Harrington has stated, the species is apparently well established.

THE INJURY. The larvæ excavate mines beneath the upper surface of the leaves, causing unsightly brownish blisters. The blisters increase in size as the larvæ feed, turn brown, merge into each other, and may entirely cover the upper surface so that the upper epidermis is completely separated, and the leaves killed. There are sometimes more than a dozen larvæ working in one leaf.

When the attack is severe the beauty of the foliage is largely destroyed, and the destruction of so much leaf surface must have the effect of weakening the trees.

THE ADULT. The adult insect is a small, shining, black sawfly about three millimetres in length, with brownish tibiæ and tarsi and dusky wings; the radial

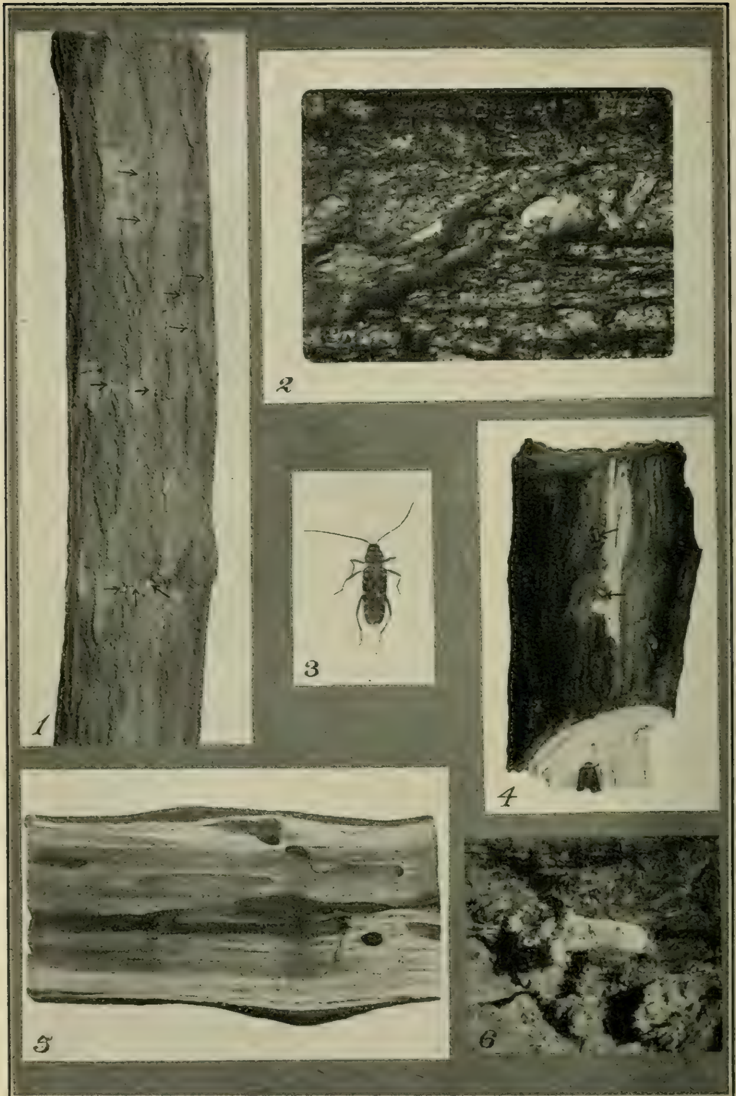


PLATE 1.—The Locust Borer, *Cyllene robiniae*.

Fig. 1.—Eggs in the bark crevices.
Fig. 2.—Eggs in situ, greatly enlarged.
Fig. 3.—The adult beetle, slightly enlarged.
Fig. 4.—The hibernating larvæ in the bark.
Fig. 5.—Larval mines in a locust trunk.
Fig. 6.—An egg, in situ, filled with boring dust.

cross-vein lies behind the second cubital cross-vein instead of immediately before it, as in the closely allied elm species, *K. ulmi* Sund.

THE EGG. The small, round, whitish egg is deposited by the female fly beneath the upper epidermis of the leaf through a slit cut with the ovipositor in the upper surface; the egg is easily recognized as a small yellowish swelling in the upper leaf surface.

THE LARVA. The larva is six or seven millimetres in length, segmented, slender, whitish in color, or greenish from the food particles ingested, the flat head the true legs brownish, and the prolegs rudimentary.

THE LIFE HISTORY AND HABITS. The eggs hatch in a few days, and the young larvæ at once begin feeding upon the pulp of the leaf; the epidermis forming the roof of the blotch mine thus produced, turns brown and makes the work of the larva conspicuous. As the mine increases in size it is frequently bounded on each side by the parellel lateral leaf veins, but when many larvæ are working in one leaf, and there may be as many as twenty in a large one, the mines coalesce and may entirely loosen the upper leaf surface, as has been done in figure 7, pl. 2. When an infested leaf is held to the light the larvæ may be seen distinctly at work within their mines, figure 1, pl. 2.

When the larvæ are full grown they break through the thin, dead, upper skin of the mine, drop to the ground, and spin a thin silken cocoon slightly below the surface; frequently grains of sand and small pebbles adhere firmly to the silk and form a framework or support for the cocoon.

The pupal period of the summer broods lasts for about two weeks. The first cocoons of the second generation were started this season in our cages on August 8th, and the first adults emerged on August 26th.

THE NUMBER OF BROODS. There has been some doubt apparently as to the number of broods each season. Dr. Fletcher has recorded two broods for Ottawa in 1891, and Professor Slingerland estimated for Ithaca "at least two or three broods, perhaps more." Our notes on this species were commenced this season early in June, at which time the larvæ were abundant in the alder leaves in the Arboretum, although none were noticed then on the native alders. The adults from these larvæ commenced emerging about the middle of July, and were abundant by July 20th. Full grown larvæ were spinning cocoons again abundantly during the latter half of August, and adults were again abroad in large numbers during the last few days of August, and the first week in September. Eggs were laid early in September, and larvæ were working in the leaves until the close of the season. The generations of the season overlapped so that medium-sized and large larvæ were present much of the summer, but there was a distinct succession of cocoons, adults and eggs at three times during the season, in late May and early June, in late July, and in the first week of September. There were three generations of larvæ in Ottawa this season, the last spinning the over-wintering cocoons.

REMEDIAL MEASURES. The larvæ may be killed within their mines very easily with strong contact insecticides, if the application is made while the larvæ are small. Kerosene emulsion and Black Leaf 40 were tested in various strengths. Kerosene emulsion at one part stock to five parts water was fairly effective when applied to foliage containing larvæ of all sizes, with 94 per cent. killed; but was ineffective at one to seven, with only 68 per cent. killed. Probably kerosene emulsion at the strength of one to five would prove satisfactory in the early season while the larvæ were all small.

Black Leaf 40, at one part to 100 gallons of water, with five pounds of soap, killed all the larvæ in the foliage sprayed. This is the application recommended. It should be applied in late May or early June, as soon as the small brown mines appear on the leaves and should be repeated as often as new mines appear from reinfestation by late appearing adults or the migration of adult females from neighboring breeding grounds.

Immune Species of Alders. The various species and varieties of alders growing in the Arboretum are effected to very different degrees by the leaf-miner. Some are very badly affected with other varieties beside them showing no signs of the injury whatever; and there is evidence that individual trees of a variety possess varying degrees of immunity.

The Locust Borer, *Cyllene robiniæ* Forst.

The Black Locust trees of Ontario and Quebec are being so seriously injured by the Locust Borer that it seems advisable to draw attention again to the available means of control. The beetle and its habits are so well known, and have been so thoroughly discussed in literature that only the briefest outline will be included here.

The adult, a beautiful black and yellow-banded, long-horned beetle, slightly over half an inch in length, emerges from the infested trees during August and September, and is found feeding upon the pollen of goldenrod flowers, and laying its eggs in crevices in the bark of living locust trees. The beetles were active at Ottawa this season between August 14th and September 17th. They were captured upon a patch of goldenrod near the infested locusts, and in smaller numbers upon the trunks of the locust trees. A larger area of goldenrod a few hundred yards beyond the first yielded very few beetles. Apparently the beetles seek the nearest goldenrod pollen, and were to be seen flying back and forth between the locust trees and their feeding ground.

The beetles are found crawling upon the bark of the locust trunks and branches, mating and depositing eggs. The female searches with the very sensitive ovipositor in the bark crevices until a suitable place is found, and deposits there an elongate white egg, neatly and securely wedged into the crevice so that very little of the egg is visible, and more safely attached by a mucilaginous secretion coating the egg-shell. The larva emerges through the hidden end of the egg-shell, and bores directly into the inner bark, leaving the egg-shell and the entrance tunnel packed with castings. In the yellow living inner bark it excavates a small shallow cavity within which it remains quiescent until the following spring. During the dormant period of the trees the larvæ are therefore very small, immediately beneath the corky outer bark and with a short overlying mine connecting them with the exterior. In the spring the larvæ extend their tunnels into the wood, sometimes penetrating to the heartwood in branches or small trunks. The tunnels are commonly lengthwise, and are always kept connected with the exterior by an opening as large as the larva, through which the borings are thrust. When full grown, late in July or in August, the larva enlarges the end of its tunnel, closes itself in with chips, and changes to the pupa and then to the adult. The adult beetle leaves the wood through the hole kept open by the larva.

The injury to the trees caused by successive generations of larvæ girdles the trunks and branches partly or completely and kills the branches and areas of bark on the trunk until finally the tree succumbs. Branches and trunks of the smaller

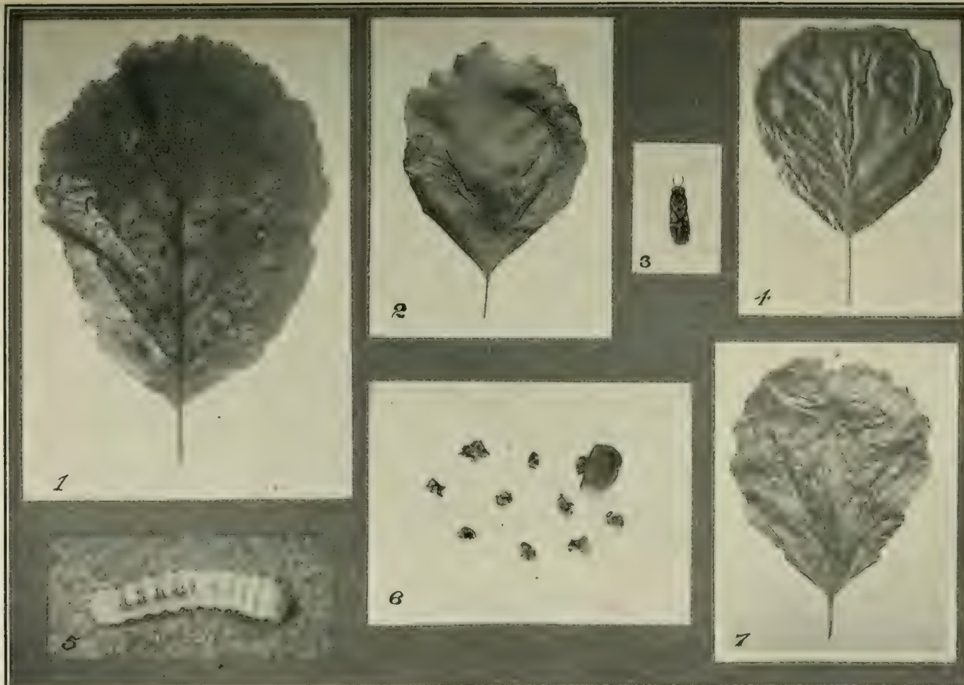


PLATE. 2.—The Alder Leaf Miner, *Kaliosyphinga dohrnii.*

Fig. 1.—Alder leaf showing the larvæ in their mines.
Fig. 2.—Larval mines.
Fig. 3.—An adult sawfly, enlarged.
Fig. 4.—Larval mines.
Fig. 5.—Larva, greatly enlarged.
Fig. 6.—Cocoons of silk encrusted with sand.
Fig. 7.—Larval mines entirely separating the upper leaf surface.

trees are often badly weakened by the numerous tunnels in the heartwood and are broken by heavy wind storms.

METHODS OF CONTROL. Locust trees are grown in this country chiefly for shade or ornamental trees or in hedges. Any cutting or removal of trees will have to do chiefly with dead and dying trees and branches. It is very important in controlling borer infestations that the infested dying and useless wood be removed and burned before the middle of July, to prevent the spread of the beetles. The dying parts can be identified in the early season, and should be cut out as early as possible, and burned as soon as it has dried sufficiently.

If the wood is to be utilized the cutting should be done in winter, or before the end of March, the valuable parts barked to destroy the young hibernating larvæ, and the worthless remainder completely burned.

SPRAYING TO KILL THE YOUNG LARVÆ. The hibernating larvæ lie immediately below the corky outer bark and can be killed by spraying the trunks and branches between October and the end of March with a strong contact insecticide. The United States Bureau of Entomology has recommended kerosene emulsion at a strength of 1 part stock solution to 2 parts water for the purpose; and this strength has been used in our experiments with satisfactory results.

THE BRONZE BIRCH BORER, *Agrilus anxius* Gory.

The cultivated birches are being seriously injured by the Bronze Birch Borer throughout much of Southern Ontario, including the Ottawa Valley. The injury is caused by the young of the beetles, slender whitish grubs, which excavate long winding tunnels through the inner bark and sapwood of the small and large branches and trunks. The trees are killed, sometimes rapidly, and in some cases slowly but surely, by successive generations of grubs. A very large number of our finest cultivated birches have already been killed and cut down, and there is good evidence for fearing that it will eventually be useless to plant white birches in the localities infested by the beetle.

A careful study of the injury was undertaken by the Entomological Branch with the object of finding some effective method of control. We are not yet able to recommend safely any other than the drastic methods suggested by Professor Slingerland years ago.

THE TREES ATTACKED. The varieties of the European white birch, *Betula alba*, are usually planted for ornamental trees in preference to our native species, and have suffered most severely; but our native yellow, white and black birches are killed by the borers when grown under cultivation. We have found the tunnels of the grubs in white and yellow birches in woodlands, but have never known the trees to be killed under natural conditions in the forests. It appears probable that certain varieties or possibly individual trees possess a certain degree of immunity from the borer attacks, and if this proves to be correct we shall have there a partial solution of the problem.

EVIDENCE OF THE INJURY. The infested tree usually dies gradually from top downwards, but by the time the top is dead the borers will be found working in a large part of the trunk and branches. The inner bark and sapwood may be thoroughly interlaced with their tunnels without much evidence of their presence appearing upon the outer surface of the bark. The infestation is betrayed to the careful observer, however, in the zigzag or winding ridges upon the branches overlying the tunnels in the sapwood, and in the "rusty" patches upon the trunk and larger branches, where sap is oozing from cracks in the outer bark caused by the tunnels within.

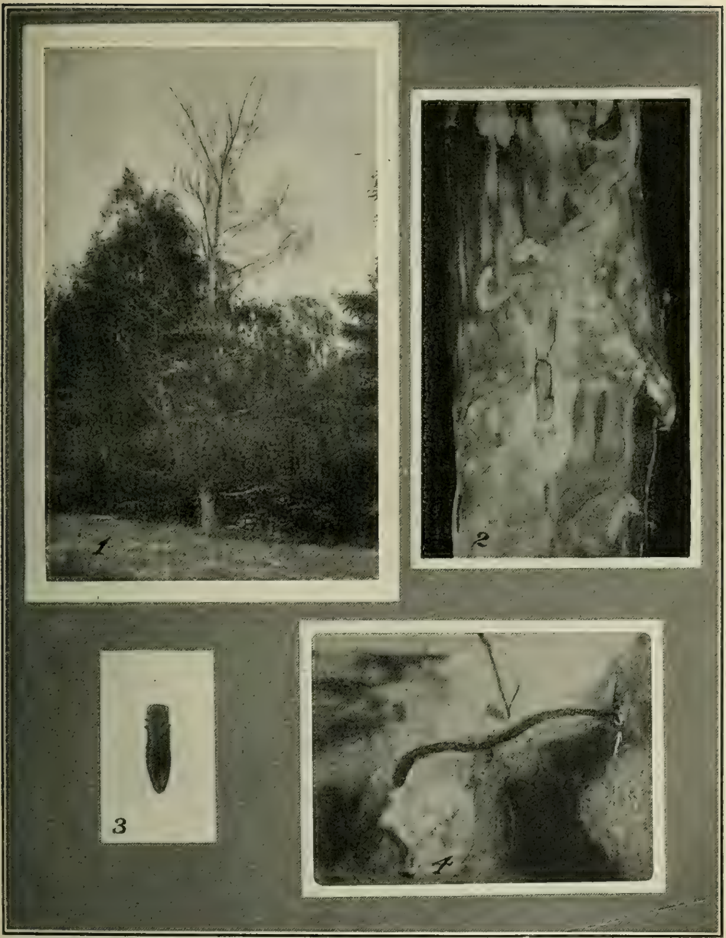


PLATE 3.—The Bronze Birch Borer, *Agrilus anxius.*

Fig. 1.—White birch injured by borers· top dead.
Fig. 2.—Larval mines on the wood surface; showing a larva in its hibernating cell.
Fig. 3.—The adult beetle.

Fig 4.—The commencement of a larval mine; one-half the entrance hole is shown at the white arrow; the mine passed slightly below the wood surface at the black arrow.

THE ADULT BEETLE. The adult beetle is slender, somewhat flattened, dark olivaceous bronze in color and slightly less than half an inch in length.

The beetles emerge from the bark of the infested trees during June and July. At Ottawa this season, the first adult appeared in our cages on June 27th, and the first adults were taken on trees in the open on June 30th. The early part of the season was very wet, and the emergence of the beetles was undoubtedly retarded thereby, since heretofore we have found adults emerging as early as June 9. The date of emergence will vary considerably with the season, the locality and the latitude. It is possible that in the Niagara Peninsula beetles may sometimes emerge as early as the middle of May, since they are recorded from Ithaca, N. Y., as early even as May 1st. The beetles were found on the trees at Ottawa this season until July 28th.

The beetles were reported by Larsen as feeding freely upon leaves of willow, poplar, birch, elm and other trees. In our experiments they have fed very sparingly upon birch leaves, but could not be induced to feed at all upon willow, poplar or elm. Neither could we find any evidence of their feeding in the open upon those trees, nor to any considerable extent upon birch. We hoped to obtain a partial control by poisoning the adults, but so far have not been successful.

THE LARVAL MINES. The females were frequently observed feeling with the ovipositor beneath bark scales, evidently searching for a suitable place for oviposition. Such places were marked and carefully examined, but neither in the field nor in our cages were we able actually to find the eggs. However, the newly started tunnels in the branches are easily traced backward to minute openings through the outer bark through which the freshly hatched larvæ have entered. It is evident that the eggs are deposited usually beneath the scales on the rougher portions of the bark of the branches and trunk. The larvæ enter the bark through minute openings, and bore directly inward through the bark to the wood surface. The tunnel is then continued between the bark and wood for a short distance, and is further continued in a winding or zigzag manner partly below the wood surface and partly between the bark and wood. Early in the autumn the mature larvæ excavate elongate hibernating cells in the ends of the tunnels a short distance below the wood surface, in which they pupate in the following season and emerge through the characteristic part-oval holes in the bark. In these cells the larvæ are folded, the cephalic third being bent over and closely pressed to the remainder of the body. At the close of the season there are, however, many smaller larvæ in the branches not more than one-half grown; these hibernate in normal tunnel-ends immediately below the bark, and continue their development the following season. There is evidence that in some individuals at least the life cycle lasts for two seasons.

CONTROL MEASURES. The only method of control that we can safely recommend at present is to cut out all infested birches and burn the entire tree, including the small branches, before the middle of May. By the time the top of the tree is dead from the action of the borers, it is useless to attempt to save the tree, since the grubs are then distributed over most of the trunk and branches, as will be evidenced by the reddish patches upon the bark. All that can be done is to preserve for three or four years a mutilated relic, and at the same time retain an ideal breeding ground for the beetles from which they will spread to the remaining birches of the neighborhood.

The results of the most promising of our control experiments will not be definitely determined for another year or longer; and in the meantime we can only urge owners of ornamental birches to watch carefully for evidence of the

presence of this destructive borer, and to adopt promptly the drastic measures that seem at present necessary for saving the remaining trees.

PARASITES. The larvæ with which we worked this summer were very heavily parasitized, while the number of beetles to be found on the trees in the open was surprisingly small. The birches about Ottawa apparently have been dying more slowly during the last few years than heretofore, and it is possible that this may be accounted for by an increase in the number of the parasites.

PROF. CAESAR: I should like to ask Mr. Swaine how many species of birch are attacked by the Bronze Birch Borer.

MR. SWAINE: We have a considerable number of species of birch in the Arboretum where our work was carried on, and there is a distinct difference in the species in the degree of immunity to attack by borers. We find the native species attacked and even killed when in isolated conditions under cultivation; out in the woods I find the native birches attacked by the borers not infrequently, but have never known the trees to be killed under such conditions. In connection with the Alder Leaf-miner we find that the different species and varieties of *Alnus* differ widely in their susceptibility to attack; some are very badly infested, and some show little or no evidence of injury.

DR. HOWARD: I was out in Ashland, Oregon, last summer, and for the first time saw the method of determining the damage by Dendroctonus beetles at a distance. Our man was able to point out at a distance Dendroctonus-injured trees. I was interested in Mr. Swaine's statement about the killing off of the new growth by the severe weather of last winter, and I was wondering whether it was possible to detect this killing at a distance, and to distinguish it from Dendroctonus-killed timber. I should be interested to have Mr. Swaine tell us just what the difference is.

MR. SWAINE: The frost-injured trees are usually in a definite belt situated along the sides of the mountains, and the effect may be seen for years, although most of the trees may recover. On Mt. Rundle at Banff, Alberta, there is a belt of such injury still showing, which occurred nine years ago. In the early season following the injury, the foliage appears yellow and gives a decidedly yellowish tint to the belt; in some cases many of the trees actually die. One sees this injury in a definite belt between certain altitudes on the upper benches. The Dendroctonus injury on the other hand appears as clumps of dead trees, "red-tops," with isolated dead trees here and there. There may be from three or four to fifteen or thirty red-tops, or more, in each clump, with here and there isolated trees. The injury is quite characteristic in the earlier stages.

MR. HARRINGTON: Does a small moth that appears in terminal twigs of the yellow pine do much permanent injury? It disfigures the trees greatly by forming large masses of gum, and appears in the terminal shoots. Have you performed any experiments with this insect?

MR. SWAINE: I do not think that species does very much damage except in disfiguring the trees. There is one particularly injurious species known to me occurring in southern British Columbia affecting yellow pine. Near Okanagan Landing there is a large patch of timber in which many trees are badly injured or killed by a species which bores in the cambium of the branches, not in the trunk, but around the branches so that it girdles and kills them. Of course all through that country there is the injury to the tops caused by boring caterpillars.

MR. HARRINGTON: Is the black pine attacked also by Dendroctonus?

Mr. Swaine: Yes, especially when mixed with yellow pine.

Prof. Zavitz: I was very much interested in Mr. Swaine's reference to the turning of logs in the booms. This work can be of great economic value to the lumbermen in our northern country, because I have known lumbermen to get gangs of men and put them on the booms all summer to turn the logs, and when they get such scientific information they will turn their logs less frequently.

Mr. Winn: Does the Locust Borer resort to other flowers to any extent besides the goldenrod?

Mr. Swaine: We have found it only on the goldenrod. We have a nice patch of goldenrod a short distance away from our block of locust trees, and we get the beetles flying back and forth between the flowers and the trees.

Mr. Winn: Some people built a house along side of mine, where I had a very fine patch of goldenrod, and the nearest place where they came from, and I cannot find them on any other flowers at all that were apparently equally attractive. I have never been able to see the beetles on the locust trees, but do not get a chance to go up in the daytime.

Mr. Dearness: Why is the brush useful against the Monohamnus beetles?

Mr. Swaine: It is because of the shade they provide. The beetles love the sunlight. We often see them on a fallen tree lying in the sunlight, but with a portion in the shade; the mating beetles will be found invariably upon the sunny end, and the shaded end will accordingly have few or no eggs laid upon it.

Prof. Zavitz: I had a very interesting experience in that connection at one time. One summer in collecting I noticed a tree had fallen from the dense woods out into the road, and I used to go to that tree during June and along early in July, where numerous specimens were to be found just outside the fence where the tree was in the sunshine, but in the shade I never found a specimen.

Mr. Swaine: It is a very convenient habit for we can use our knowledge of it in protecting logs which have to be left in the woods.

Mr. Dearness: Does the temperature have anything to do with the hatching?

Mr. Swaine: I do not think the females would go into the dense shade to oviposit at all.

Mr. Harrington: I think most of the Cerambycidæ prefer to oviposit in the sunlight.

NOTES ON SOME INSECTS OF THE SEASON.

L. Caesar, O. A. C., Guelph.

It may be worth mentioning that in the Niagara district at least, and apparently in most other parts of the Province, there was a wonderful diminution in the number of most kinds of insects this year, compared with the average season. This may have been due to the abnormally wet May and June destroying the immature stages.

The Clover-hay Moth (*Hypsopygia* (*Pyralis*) *costalis*).

This year for the first time I found the work of this moth on a large scale on July 13th, at Wellington, Prince Edward County. Pea straw from the canning factory had been dried and stored in an open shed some two or more years ago, and in this the insect had bred. At the time of my visit most of the adults had emerged, though there were still a good many pupæ and a few larvæ. The moths

were so numerous that they were to be seen in thousands on the inner side of the walls and roof. I pulled out the straw to a depth of a yard, and found that the larvæ had been working at least that far in. They had fed both on the straw and on the empty pods. The pupæ were all near the outside. Along with this species was a considerable number of the Meal Snout-moth (*Pyralis farinalis*), the larvæ of which had doubtless fed on the peas that had been left in the straw.

EVETRIA ALBICAPITANA Busck.

This pretty Tortricid described by August Busck, in 1914, as a new species was found in considerable numbers in the forestry plantation at St. Williams, on June 9th. The larvæ feed on the bark of the new growth at the axils of the twigs

Evetria albicapitana Busck.
Moth and gum mass caused by larva on twig of Jack Pine. Natural size (original).

and cause irregularly globular to irregularly hemispherical gum masses from 1-3 to ¾ of an inch in diameter. They seldom, if ever, completely girdle the twig or cause it to die. There were sometimes two or more gum masses on each branch, but even so the branch looked uninjured. On June 9th a few of the live pupæ

were still to be found in the gum, but about 90 per cent. had emerged. The adults were present, and flew out from the trees when disturbed or dropped as if dead to the ground, where their yellowish brown color made them very difficult to distinguish from the fallen staminate flowers. Three females and one male were placed in a bottle along with two fresh new-growth twigs and brought home. After a few days eggs were laid near the base of the young leaf clusters, some separately and some in very irregular clusters, one egg overlapping another shingle fashion. It is doubtful whether in the open they would be laid in clusters. The eggs were cream-colored, flattened, or scale-like and oval in outline, about .5 mm. long by .4 mm. wide. They darken before hatching. Jack Pine (*Pinus banksiana*) (*divaricata*) alone was attacked. (See figure of moth and work of larva.)

The Willow and Poplar Curculio (*Cryptorhynchus lapathi*).

Once more we have found adults of this species in the spring in the nurseries. The excessively wet weather prevented our watching them to see whether they laid any eggs. The insect has been reported from the following places in addition to those given in my last year's account of it: Port Elgin in a nursery, Beachville, Strathroy and Lake Simcoe district. Mr. George Matieu, has also informed me that he has taken it on *Populus deltoides* in a nursery at Berthierville in Quebec.

Fruit-tree Leaf-roller (*Tortrix* (*Cacoecia*) *argyrospila*).

Up to the present time there have been no reports of the presence of this pest in any other orchards than those mentioned in my paper on Apple Leaf-rollers last year. I visited two of these orchards this year in June and July. In the orchard near Hamilton, the insect seems to have largely disappeared, in the other orchard —the large block of 60 acres in Norfolk County—it still persists, and has now spread throughout all the trees. I have had no chance to visit this orchard since the eggs were laid, and so form an opinion on the amount of destruction the insect is likely to do next year. The foliage in the orchard this year was kept heavily covered with nearly double strength of arsenicals, but the result showed clearly that arsenicals alone would not control this pest. Nine or ten acres of spy trees which formed the worst infested part last year, were sprayed this spring before the buds burst with Scalecide, and were noticeably freer from injury than the unsprayed parts. The owner believes that in spite of the cost, he will have to use Scalecide on the whole orchard next spring. In the orchard near Hamilton, the worst infested block was also sprayed with Scalecide, and apparently this was the reason for the great decrease there in the number of the larvæ.

The Oblique-banded Leaf-roller (*Tortrix* (*Cacoecia*) *rosaceana*).

The following additional data was obtained on this pest:

1. The number of eggs that may be laid by a single female is much greater than we had suspected. One female laid one large and two small clusters, or a little over 300 eggs in all. The highest number of eggs we found in a single cluster was 175; the average seemed to be about 100.

2. This species in Ontario is partly single brooded and partly double brooded. In our cages all the larvæ reared from the eggs laid on leaves in June and early July fed for a short time on the foliage, skeletonizing it very much in the way the Pear Slug skeletonizes pear and cherry leaves, and then while still not farther

advanced than the second instar each larva spun about itself a little silken case or hibernacula. I examined some of these hibernacula on August 26th, and found the larvæ still healthy and looking the same as when the cases were constructed. Some of the hibernacula were on very small twigs and were situated alongside the terminal bud; others on these same twigs were in the axil of the leaves, but attached to the twig not to the leaf; others were situated on larger branches in various positions. The latter were usually about the shape of a bud scale and dark on the outside, lined with white silk and easily mistaken for the hibernacula of the Bud Moth. The former were usually whitish in color, from 3 to 5 mm. long and about 1 mm. in diameter.

It is clear, however, that not all the larvæ of this brood formed hibernacula, because throughout most of August we found larvæ, some a little more than half grown, others full grown, and from these we reared adults. We also found adults at Guelph, and at Grimsby, up to September 27th. To make sure there was no mistake we sent these to Mr. August Busck, who verified our determination. Unfortunately our having to shift our quarters from Grimsby to Guelph at the end of August, prevented us from carrying the life-history through. Prof. Herrick, however, states that there is no doubt that eggs are laid in the fall on the bark and that these winter.

Mr. A. G. Dustan, Annapolis Royal, Nova Scotia, in the 1915 report of the Nova Scotia Entomological Society, states that the insect in Nova Scotia winters in the immature larval stage in hibernacula. He seems to imply that this is the only stage in which it winters there.

Red-necked Agrilus (*Agrilus ruficollis*).

A red raspberry plantation near Grimsby was much injured by the larvæ of this insect; the injury was much greater than I had ever seen before. Approximately 25 per cent. of all the canes were infested, and in consequence the crop was lessened to about that extent. An examination of the new canes at the middle of August showed that the injury next year would be as great as this year. Since the adults do not emerge until long after the leaves are out, and since the tops of a large percentage of the infested canes die before the adults leave them a very helpful means of control would evidently be to go through the plot about a month after the leaf buds burst and remove these canes, cutting them low down to be sure of not missing any of the insects in them, and then burn all the cut canes promptly. The tendency of this pest to localize itself was well shown by the fact that it was doing very little injury in any of the surrounding plantations of the same or different varieties.

Apple Capsids or Mirids.

Some further study of certain points about these Leaf-bugs has been made and the following data obtained:

1. *Neurocolpus nubilus*, or the Clouded Leaf-bug as we may call it, has almost disappeared from the large Norfolk apple orchard where it had been very abundant for several years. On July 9th in a half day spent in the orchard I saw only 15 of these. The disappearance was not due to lack of eggs for many of these had been laid last summer. It may have been due to the very wet weather this spring.

2. In at least some of the orchards *Lygidea mendax*, the so-called False Red-bug, was much less numerous than last year. One of these orchards had been sprayed

with a tobacco extract and was almost totally free from the pest. The spraying doubtless helped to bring about this result.

3. The eggs of *Neurocolpus nubilus* do not hatch until more than a week after the blossoms drop, or in fact until after the Codling Moth spray has been applied. This was true last year as well as this year. The first nymph seen this year was on June 9th. The two species of Red-bug, *Heterocordylus malinus* and *Lygidea mendax*, began to hatch a week or more before the blossoms opened. The most practical time to spray for these latter two is just after the blossoms fall, combining tobacco extract with the Codling Moth spray for the purpose. This date, however, would be worthless against *Neurocolpus nubilus* as it would still be in the egg stage, Moreover, as we discovered last year, tobacco extract even at three times the usual strength for green aphids is ineffective against this pest; for it merely stupefies the nymphs and they soon recover. A soap solution, such as one pound of Sunlight soap to 10 gallons of rain water was found satisfactory.

4. The time of the appearance of the adults of the different species this year as observed by us was as follows:

Heterocordylus malinus, June 23rd in the cages, a few a little earlier in the orchard.

Lygidea mendax, June 29th,

Paracalocoris colon, July 6th.

Neurocolpus nubilus, July 10th.

5. Apparently *Lygus communis,* Knight, n. s., the troublesome False Tarnished Plant-bug of New York, and Apple Green Bug of Nova Scotia if present in Ontario plays no part, or a very small part, in injuring apples and pears. *Lygus invitus* occurs almost everywhere, but as shown by Knight does not attack fruit trees.

Local Pests.

Melon Aphis (*Aphis gossypii*) was very abundant and destructive on melon plants in Kent County.

Beet Leaf-miner (*Pegomyia vicina*) injured severely the foliage of mangolds north of Brockville.

Corn Seed-maggot (*Pegomyia fusciceps*) nearly destroyed some fields of beans in Prince Edward County. The fields had been in sod.

Zebra Caterpillar (*Mamestra picta*) was abundant enough on turnips in part of Peel County to be an important pest.

Hickory Leaf-roller (*Eulia juglandana*) was very common on hickory trees in some parts of the Niagara district.

American Tent-caterpillars (*Malacosoma americana*), though rapidly diminishing in numbers east of Toronto, were very abundant at Oakville and Port Credit, and also in parts of Norfolk and Lambton Counties.

Blackberry Leaf-miner (*Metallus bethunei*) attacked in considerable numbers the blackberry foliage at Vineland.

Pear Slug (*Eriocampoides limacina*) was conspicuous by its absence in the Grimsby district.

THREE IMPORTANT GREENHOUSE PESTS RECENTLY INTRODUCED INTO CANADA.

ARTHUR GIBSON, CHIEF ASSISTANT ENTOMOLOGIST, DEPARTMENT OF AGRICULTURE, OTTAWA.

It is important that attention be directed at this meeting to three serious greenhouse pests which have recently been introduced into Canada, namely, the Florida Fern Caterpillar, the Chrysanthemum Midge, and the Rose Midge.

THE FLORIDA FERN CATERPILLAR, *Callopistria* (*Eriopus*) *floridensis* Gn.

This southern insect which was described from Florida in 1852 has occasionally been recorded as a serious greenhouse pest. In the Year Book of the United States Department of Agriculture for 1908, the Bureau of Entomology records important losses in greenhouses in Washington, D.C., one florist reporting damage to ferns to the extent of $4,000. This is apparently the first record of this insect as an economic pest. In addition to being destructive in the District of Columbia, this insect has since been recorded as doing serious damage to ferns in the States of Florida, New Jersey, Illinois, Georgia and Ohio. The caterpillar is also believed to have occurred on ferns in Louisiana. Hampson[1] records the species from Florida, Mexico, Guatemala, Costa Rica, Bahamas, Jamaica, Cuba, Haiti, Sta. Lucia, St. Vincent, Venezuela, Br. Guiana, Brazil and S. Trinidad.

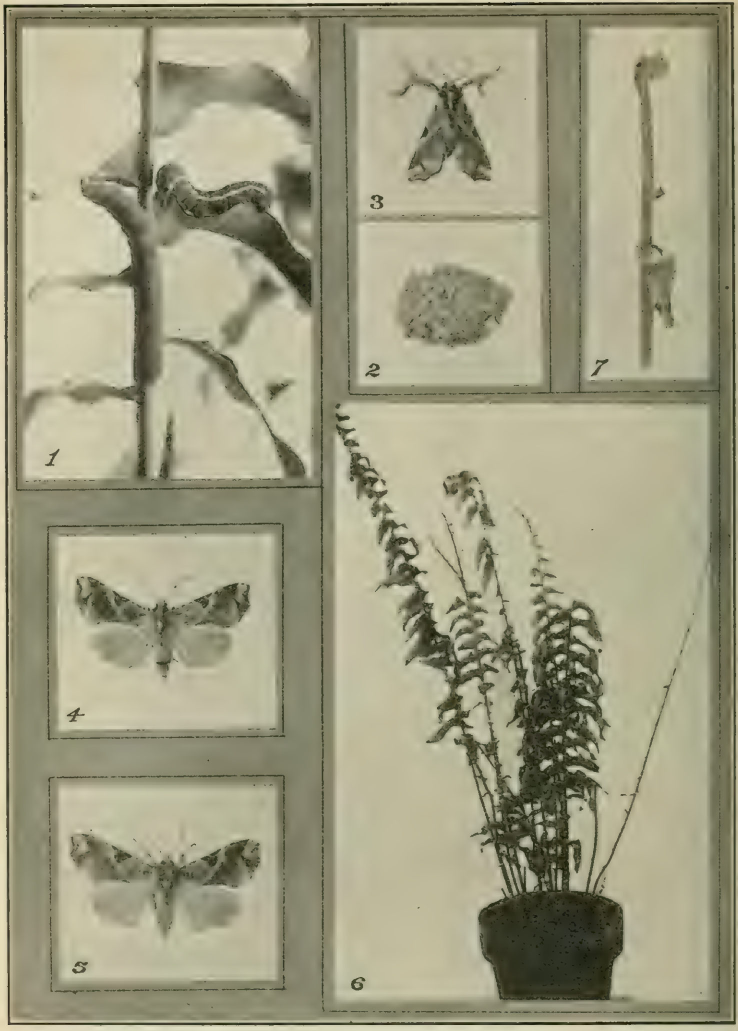
The first occurrence of the Florida Fern Caterpillar in Canada was noted in September, 1915, in the greenhouse of Mr. A. M. Barton, Weston, Ont. The caterpillars were found on some ferns imported from Chicago, and the insect had doubtless been introduced with such shipment. During the winter of 1915-16 we had an opportunity of studying the life-history of the insect and observing its habits. Recently Mr. Hall, of Messrs. Hall and Robinson, forwarded to us specimens of the larvæ from their Montreal West greenhouses, where they were first observed in September, 1916.

LIFE-HISTORY.

The Egg.

We have been unable to secure eggs of the moth, either by searching in the greenhouse referred to or from living moths kept under observation in captivity. Mr. C. E. Petch, Field Officer of the Branch, and the writer have both examined ferns which were being destroyed, as has also Mr. Barton, without any eggs being detected. Davis[2] describes the egg (laid in confinement) as "circular in section, about one-fiftieth of an inch in diameter, slightly flattened, ribbed longitudinally and transversely," and states that in color it "is pale greenish with a faint yellowish tint, much resembling the color of the new fern fronds." The same author states that in confinement the moths deposited their eggs singly on the under surface of the new leaves. Weiss[3] records an incubation period of from five to seven days.

[1] Cat. Lep. Phalaenae in the Brit. Museum, Vol. VII., p. 549.
[2] 27th Report State Entomologist of Illinois.
[3] Can. Ent., XLVII, 23.



The Florida Fern Caterpillar, *Callopistria floridensis* Gn.

Fig. 1.—Two forms of larva.
Fig. 2.—Cocoon.
Fig. 3.—Moth at rest.
Fig. 4.—Female moth.
Fig. 5.—Male moth.
Fig. 6.—Boston fern plant showing injury by larvæ.
Fig. 7.—Tip of frond destroyed by larvæ.

(Original.)

Description of Larval Stage.

During January, February and March, 1916, several lots of larvæ representing various stages were received at Ottawa. From these the following notes were made:

First Instar. Length 3 mm. Body pale green, no markings. Head concolorous with body, ocelli black. Tubercles black, conspicuous, each with a single, rather long hair. Thoracic feet semi-translucent; prolegs concolorous with body. Spiracles black.

Second Instar. Length 5.5 mm. Head pale green, shining, of a glassy appearance, ocelli black, mandibles reddish. Body pale green with the following rather indistinct stripes: addorsal, subdorsal, and a stigmatal band, all pale whitish in color. About midway between tubercles ii and iii is a rather wide, conspicuous, blackish band. Tubercles black, setæ dark. Feet concolorous with body.

Third Instar. Length 9 mm. The larva in this instar is similar to second instar but the longitudinal stripes are now quite distinct, the addorsal being sinuous in outline. Spiracles pale yellowish, rimmed with black.

Fourth Instar. Length 14 mm. Head green, cheeks pale brownish, clypeus margined on outer sides with blackish. Body green with a more or less yellowish reflection. All the markings distinct: addorsal and lateral stripes and stigmatal band yellowish, the two former quite sinuous in outline. Subdorsal stripe margined below, as before, with a blackish band. Thoracic shield margined anteriorly with black. Spiracles yellow, black rimmed. Feet concolorous with body.

Fifth Instar. Mature Larva. Length 28 mm. Head reddish brown, reticulate with dark brown; clypeus with pale margins; ocelli black; epicranium adjoining clypeus brownish; a noticeable pale space without markings is present immediately above base of each antenna. The color of the body is now totally different, being raw umber,[1] with a faint greenish tinge. The stripes are inconspicuous unless examined with a lens and of a sordid yellowish-white color. All are sinuous in outline. Tubercles blackish, each distinctly surrounded with a ring of sordid yellowish-white; setæ blackish; spiracles pure white with black rim. Between tubercles i and ii there is a conspicuous yellowish-white spot, and on each segment midway between the stigmatal band and subdorsal stripe, a lateral row of the same colored spots. The skin below spiracles is also spotted and streaked irregularly. The stigmatal band on the thoracic segments is partly filled with pale yellow, particularly on segment 2 and in the anterior half of this segment the color is white instead of yellow. Anterior edge of thoracic shield dark brown, forming a distinct band. Thoracic feet shining, pale brown; prolegs dull, concolorous with venter. Length when mature 33 mm.

The above notes were made upon a single larva received on March 1, which was collected with many others by Mr. Petch on February 29.

In February (1916) several larvæ in last stage were received from Mr. Barton. All but one were green, the exception being of a dull reddish color. In the sending from Mr. Petch, received on March 1, several instars were represented. All these specimens were also green, with the exception of two, one of the latter being a dull brown and the other a beautiful reddish-chocolate color. The mature specimens were described as follows:—

Green larvæ.—Length 32 mm. Body yellowish-green. Markings as follows: An addorsal line, a subdorsal line, a lateral line, and a rather indistinct stigmatal

[1]According to Ridgeway, Nomenclature of Colors, 1912.

band, all whitish-green in color. In some specimens the skin between the subdorsal line and the lateral line is of a darker green color and for this reason contrasts rather strongly. Close to the spiracles there are one or two blackish spots on each of the central segments. On the thoracic segments and, in some individuals, on the two or three posterior segments, these spots are more frequent and form a distinct, uneven band, widest on the thoracic segments on segment 2. The color of the intersegmental folds particularly on dorsum is yellow, spiracles cream-colored, ringed with black. Thoracic shield slightly paler than color of dorsum and having a distinct band of black along anterior edge, which joins with the band on sides of thoracic segments. Ventral area glaucous. The head varies in color from pale green with a light tinge of reddish-brown on cheeks to a decided reddish-brown over whole upper portion of cheeks; clypeus bordered on either side with a blackish, rather indistinct, band; mandibles reddish; ocelli blackish, a blackish patch above ocelli.

Brown larva.—Length when extended 37 mm. Head same as in green specimens, but with brown reticulations. Body dull velvety brown with a purplish reflection. Longitudinal lines pale whitish, indistinct. Tubercles blackish, circled with pale whitish. Spiracles cream-colored. The lateral spots close to the spiracles which were black in the green larvæ are in this specimen white and conspicuous, continuing as a striking band on the thoracic segments. Thoracic feet reddish-brown; prolegs concolorous with venter.

Reddish-chocolate larva.—Similar in general to the dull brown larva but having a wide continuous white stigmatal band, as shown in figure 1, page 112.

On March 27 another mature green specimen was described as follows: Length at rest 28 mm. Head 2.8 mm. wide, yellowish-brown; clypeus paler; ocelli black. Body green, slightly darker than the leaves of Boston fern. Stripes yellowish-white as in other specimens. Stigmatal band with more yellow than dorsal and subdorsal stripes and with white areas on first two thoracic segments. Spiracles more or less surrounded with dark purplish-red, particularly on central segments. Thoracic shield paler than body. Venter pale green.

From the above notes it will be seen that the larvæ varied considerably, particularly in color. Such variation has also been noted by Davis[1] and Chittenden.[2] The former, referring to such variation, says: "There are two types of the full-grown caterpillars, one apple-green and the other velvety black, the former predominating." As indicated above, the dark-colored specimens which we examined were of a dull brown color, none were black. The band which extends across the front of the thoracic shield is very distinct and constant, and should serve as a characteristic mark to determine the species.

Description of Cocoon and Pupa.

Most of the larvæ under study were kept in a large breeding cage in which an average sized Boston fern was placed. When the specimens in such cage reached maturity they left the plant and made earthen cocoons (Fig. 2, page 112), on the surface of the soil. The earth chosen for the making of the cocoon is held together by many strands of silk which gives the structure considerable strength. It is by no means fragile, as are the earthen cocoons of our common cutworms belonging to the genus *Euxoa*. In length the cocoon varies from 18 to 20 mm. and in width from 6 to 7 mm.

[1]Davis, J. J., 27th Report of the State Entomologist of Illinois, 1912, p. 91.
[2]Chittenden, F. H., Bulletin No. 125, U.S. Bureau of Entomology, 1913, p. 7.

Pupa.—Length 12-15 mm., 5-6 mm. wide; shining reddish brown, darker at posterior end; cremaster two-spinned, the spines short, stout, and projecting outwardly towards the venter. Wing-covers prominent and slightly wrinkled.

Length of Larval and Pupal Stages.

The larva described in the five instars, received at Ottawa on March 1, was, as noted, 3 mm. in length, and undoubtedly a day, or at the most 2 days in age. It reached maturity on March 26, on which date it began to make its cocoon. By the morning of March 29 the pupa was formed. Another larva also began to make its cocoon on the same day and in this instance too the pupa was formed on the morning of March 29. The larval period, therefore, was about 27 days.

These larvæ had been kept separately in specimen tubes in which there was some earth. Each spun its cocoon on the side of the tube which rested on the earth in the breeding cage. Only sufficient of the earth was used by each larva to make a suitable cover, the glass furnishing the bottom, so to speak, of the cocoon. The obtaining of the length of the pre-pupal period, therefore, was a simple matter.

A moth emerged on April 12 from one of the two pupæ mentioned, the pupal period in this instance being 14 days. The second pupa died. Moths from other pupæ emerged during the period April 1 to 10.

Description of the Moth.

The moth is a rather striking species and quite different from any other form found in Canada. At first glance it reminds one of certain species of the old genus *Plusia*. The fore-wings in general are brown, with a darker velvety, rather Y-shaped costal area near the centre of the wings. Towards the apex of the wings and at the base of each wing the color is also dark brown. Some specimens are, in general, of a darker brown shade than others. The markings on the wings are shown in the figure herewith. (Figs. 4, 5, page 112.) The bands across the fore-wings are whitish tinged with pink. The hind wings are of a uniform paler brown color, lighter towards the base. The body corresponds in general to the color of the wings. In the male there is a conspicuous widening of the antennæ near the head. The legs are conspicuously tufted. With the wings expanded the moth measures from about 30 to 34 mm.

Habits.

Food Plants. The ferns attacked in Mr. Barton's greenhouses, Weston, Ont., were Boston, Whitmani and Scotti. Mr. Petch visited the greenhouses on February 29 and found that over 75 per cent. of the fronds had been destroyed. In the Montreal West greenhouse the same varieties were attacked, about 200 plants being more or less injured.

Nature of Injuries. The caterpillars are very active feeders and when several occur on a single plant they soon effect serious damage. Like other noctuid larvæ they prefer the young and tender leaves but will readily attack the older and larger leaves, and even eat into the more tender portions of the stems. In an experimental cage one frond measuring 16 inches in length was entirely denuded by one last stage larva in four days. Mr. Petch, at the time of his visit in February, noticed that the smaller larvæ when disturbed dropped from the plants by means of a silken thread. They were found feeding early in the afternoon. In report-

ing upon the injury he referred specially to the destruction of the growing tips of the fronds before they unroll (see fig. 7, page 112).

On May 10 I visited Mr. Barton's greenhouses and examined his stock of ferns which had been attacked by the caterpillars. They were, indeed, an unsaleable lot, the fronds of most of them being eaten to a greater or less extent and in many instances the plants almost entirely defoliated. Many had been destroyed to the extent shown in figure 6, page 112. Mr. Barton informed me that when the outbreak was at its height from three to a dozen larvæ could be shaken from a plant growing in a 5-inch pot. A large stock, particularly of Boston ferns, were in the houses, very few of which had been sold during the entire winter. Mr. Barton estimated that his loss would easily total one thousand dollars.

When not feeding the caterpillars rested on the stems chiefly towards the base of the plants. The moths being nocturnal in habit are seldom seen during the day time.

On November 4, 1916, I again visited Mr. Barton and found that the insect had re-appeared in the greenhouse. The latest month in spring during which caterpillars were found in the greenhouses was June. During the summer 2,500 ferns were placed outside in a cold frame, no ferns being kept in the greenhouses during the summer of 1916. About the middle of August the caterpillars were noticed to be destroying the ferns in the cold frame. About 2,000 ferns, in fact, were so badly infested that they were destroyed. The remaining ferns from the cold frame were brought into the greenhouse about October 1st and it was on these plants that the caterpillars were feeding at the time of my visit on November 4.

Towards the end of November, 1916, Messrs. Hall and Robinson, Montreal West, Que., informed us that they also observed the caterpillars feeding outside in a cold frame, the plants attacked being Holly Ferns and also *Pteris albolineata* and *P. winsetti*.

Means of Control.

The following methods of control were adopted in the Weston greenhouse:

Tobacco Smoke. In January fumigation with tobacco smoke was tested twice within twenty-four hours, the strength in each experiment being two pounds of tobacco stems to 16,000 cubic feet of space. At the time of the fumigations many larvæ were present. Two days later Mr. Barton could not find a single caterpillar, dead or alive, and he thought at the time that the fumigation had proved entirely successful. Later (February 24, 1916), however, the caterpillar re-appeared, but he reported that such fumigation would not be then possible owing to the fact that the houses contained many small seedlings.

Handpicking. Large numbers of the larvæ were destroyed by handpicking in the Weston house. On occasions the pots were shaken individually and the caterpillars which dropped immediately destroyed. In the United States, also, this rather laborious method has been successfully used. When the shaking is done over the ground the caterpillars are simply crushed with the foot as they fall.

As mentioned above the moths are nocturnal in habit. Oftentimes specimens may be disturbed in the house or may be attracted to a bright light hung in the evening near infested plants. An endeavour, of course, should be made to destroy all specimens seen.

Arsenate of Lead. Experiments with arsenate of lead did not prove successful. Two sprayings at the strength of one-half pound of arsenate of lead to ten

The Chrysanthemum Midge, *Diarthronomyia hypogaea* H. Lw., and the Rose Midge, *Dasyneura rhodophaga* Coq.

Fig. 1.—Galls on leaves of chrysanthemum resulting from the attack of the Chrysanthemum Midge.
Fig. 2.—The Chrysanthemum Midge, much enlarged.
Fig. 3.—The egg, larva and puparium of the Rose Midge.
Fig. 4.—Showing rose bud destroyed by larvæ of the Rose Midge.

Figs. 1, 2 and 4 original; 3 redrawn after Webster.

gallons of water were applied at an interval of five days. Later the plants were again sprayed twice at double the above strength, but even at this latter strength control was not secured. In addition, too, the white deposit remaining from such sprayings was difficult to remove even with forceful watering.

Pyrethrum Insect Powder. Sprayings with fresh pyrethrum insect powder in the strength of two and one-half ounces to five gallons of water were recommended. In New Jersey[1] the following spray has proved successful:

Fresh pyrethrum insect powder	1 ounce.
Common laundry soap	½ ounce.
Water	1 gallon.

The soap should be dissolved in a small quantity of warm water after which the insect powder and water should be added to make up one gallon of mixture. One large fern grower applied such a spray once a week for five or six weeks. The insect powder applied dry by means of a bellows also gave satisfactory results.

THE CHRYSANTHEMUM MIDGE, *Diarthronomyia hypogæa* H.Lw.

In 1915[2] the Chrysanthemum Midge was found to be thoroughly established in a large greenhouse at Ottawa. It had undoubtedly been introduced on some chrysanthemum plants imported from the United States. In addition to the Ottawa infestation we have recently received infested material from a florist in Victoria, B.C. This latter outbreak occurred in the greenhouse of Mr. A. J. Woodward, and the injury was first noticed in August, 1915, on chrysanthemums growing outside as well as within the greenhouse. Although these two occurrences are the only Canadian records we have, it would not, of course, be surprising to learn of other greenhouses being infested. Felt[3] states that he has received the insect from the States of Michigan, California, and Oregon, and the same author has reently informed me[4] that during the present year (1916) he also received the species from the States of South Dakota, Washington and Delaware. The pest is, therefore, widely distributed in North America. In referring to its "Distribution and future probabilities" Felt[5] says: "This species has been recorded from central and southern Europe, and, as stated above, it has already become established in several widely separated localities in this country, probably by the shipment of infested plants or cuttings. It was very likely brought to America without the normal quota of parasites and for a time at least it may prove to be a somewhat difficult insect to control, though it would seem as if the native parasites of our large and varied gall midge fauna might in time prey most successfully upon this midge."

LIFE-HISTORY.

The Egg.

The egg is small and in color pale orange; in shape elongate-oval. It is described by Felt as "Reddish-orange, length .15 mm., diameter .03 mm., the extremities narrowly rounded."

On April 8, 1916, a female was enclosed with a small plant beneath a bell jar. While under observation she was most active running about on the new leaves,

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[1]Weiss, H. B., Can. Ent., XLVIII, 141.
[2]46th Rep. Ent. Soc. Ont., 1915, 14.
[3]31st Rep. N.Y. State Entomologist, 51.
[4]In litt., 16 Oct., 1916.
[5]31st Rep. N.Y. State Entomologist, 54.

the favorite places chosen for oviposition being the leaf hairs near the crevices between the young forming leaves. Repeatedly the female would come back to apparently the same spot. With the exception of an absence of seven minutes, the female was observed to be actively engaged in such conduct for a period of twenty-seven minutes. On another occasion eggs were found near the tip of another plant, and were laid, as Felt has already recorded, along the surface of the leaf among the leaf hairs. On one occasion (October 27, 1916), in the Ottawa greenhouse a string of extruded eggs was found attached to a dead female which had not been able to free itself from the gall, and other eggs laid among the leaf hairs were present on the gall. Altogether 44 eggs were counted. The length of the egg stage is estimated by Felt to be probably twenty-four hours or less.

The Larva.

The mature larva is very similar to that of other cecidomyids; in color it is yellowish, or yellowish-orange, in shape plump, rounded at either end, the segments being distinct; in length about 1 mm.

The Pupa.

The pupa is about 1.75 mm. in length. The abdomen is whitish or pale-yellowish; thorax and wing covers pale yellowish-brown, cephalic horns distinct, eyes showing black; leg-cases whitish or pale yellowish.

The Adult.

(Fig. 2, page 117.)

The midge is a small two-winged fly, the length of the body being about 1.75 mm. The wings are transparent, the margins being light yellowish. The body is mostly of an orange color, the legs yellowish.

The Gall.

The gall is a conspicuous oval-shaped swelling, in length from about 2 mm. to 2.5 mm. It is often slightly paler than the color of the leaf or stem upon which it occurs, but on some plants particularly on the stems it is concolorous and inconspicuous. When the flies have emerged the galls are readily seen, particularly on the older leaves, owing to their having turned yellowish or whitish in color.

Habits.

Food Plants. In the Ottawa greenhouse all varieties of chrysanthemums were seemingly attacked. A large number of different varieties were being grown and the kinds which were noted to have been most freely attacked are the following: Chrysolora, Naomah, Radoelii, Ramapo, Hortus Tolsoms, Mrs. Clay Frick, December Gem, Madam G. Rivol, Dr. Enguehardt, Anna, Pacific Supreme, Early Snow, Elberon, Ursula Griswold, Aesthetic and Etherington. The varieties Bob Pulling, Gertrude Peers, Daily Mail, Oconta, Mrs. G. C. Kelly, W. Wood Mason, F. T. Quilleton, and E. T. Quittington were fairly free from injury. All of the above varieties are, of course, the blended product of *Chrysanthemum indicum* and *C. morifolium,* both of which grow wild in China and Japan.

In the Victoria greenhouse these varieties were infested: Smith's Advance, Halliday, Ivory, Polepheum, Chrysolora, Bonnafon, Wm. Turner, Western King,

Mrs. Thompson, Englehart, various Pompons. Of these varieties Smith's Advance, Ivory, Bonnafon, Wm. Turner, Western King, and Englehart were practically ruined.

Felt[1] states that the insect has been recorded from central and southern Europe as infesting *Chrysanthemum leucanthemum*, *C. corymbosum*, *C. atratum*, *C. japonicum* and *C. myconis*. In America the pest was first noticed on the variety known as Mistletoe.

Nature of Injury. The gall (fig. 1, page 117) which is caused by the larva irritating the plant tissues occurs commonly on various portions of the chrysanthemum plants. In the Ottawa greenhouse the galls were commonly found on the leaves, stems and buds. The galls at one time were so abundant on some young plants as to entirely deform them, as a result of which development was largely stopped and no flowers borne. Many of the single-stemmed plants show conspicuous malformation of the stem resulting from early attack of the insect. In the material received from the Victoria greenhouse the galls were found freely on the stems and leaves. On some of the terminal leaves the presence of the insect in conspicuous numbers had prevented growth and the leaves were clumped together in more or less rosette fashion.

Means of Control.

In the Ottawa greenhouse some control work was conducted under the immediate direction of Mr. J. McKee. The greenhouse was fumigated during the winter of 1915-16 with hydrocyanic acid gas about once every month. Such fumigation destroyed the adults. The house was also fumigated with tobacco. The cuttings from the stools were dipped before potting (in early December) in nicotine solution in the strength of $^3/_4$ of an ounce to one gallon of water; the plants were dipped a second time when repotted from 2½-inch pots to 4-inch pots, and a third time when transferred from 4-inch pots to 6-inch pots. During July and August (1916) the chrysanthemums were sprayed with nicotine, in the same strength, every three weeks. Since the first week of September to the present date (October 16, 1916), the house has been fumigated with tobacco once every ten days.

While the midge is still present in the greenhouse, it is by no means the pest it was in 1915. The above treatment has undoubtedly kept the insect down.

In Mr. Woodward's greenhouse in Victoria, B.C., the following remedies were tested: During the first week of treatment the plants were fumigated with Black Leaf 40 every night; in the following week they were fumigated three times, and sprayed twice with Campbell's Nico Soap; during the third and fourth week the plants were fumigated twice each week and sprayed once each week. Mr. Woodward reported that as a result of this one month's treatment he had succeeded in killing many adults, and thought he was slowly getting the insect under control. The fumigation he reported was used as strong as the plants would stand without burning the foliage.

The Rose Midge, *Dasyneura rhodophaga* Coq.

In the report of the Dominion Entomologist for the year ending March 31st, 1915, a brief mention is made of the occurrence of this pest at London, Ont., specimens of the infested shoots of the variety Mrs. J. Laing having been received at Ottawa in July, 1914. This was apparently the first record of the Rose Midge in Canada. The grower reported that the buds on about 300 plants in his rose

[1]31st Report of the State Entomologist, New York, 1915, p. 51.

garden had been injured, (see fig. 1, page 117). The following summer the pest was again present in the same garden and Mr. W. A. Ross, Field Officer of the Branch, obtained infested material and reared the adults. Some of the latter were forwarded to Dr. Felt who confirmed the determination of the insect. Regarding the injury, Mr. Ross reported: "All 'Hybrid Perpetuals' and 'Hybrid Teas' are subject to attack. Mrs. John Laing is apparently the most susceptible variety. H. T's with strong terminal shoots like those of Killarney are partially immune. All the Polyantha, Bourbons, Hybrid China, Noisette and Wichuraiana roses appear to be immune."

The only other outbreak of the insect in Canada is its occurrence at the present time (autumn of 1916) in the greenhouses of Miller & Sons, Toronto. Its work was first noticed in these latter houses in September (1916). The buds of the young shoots did not develop and on investigation it was found that they were being destroyed by the larvæ. The varieties of roses which have been severely injured in the Toronto greenhouses are Ophelia, Milady and Stanley. The variety Richmond was very slightly attacked. Mr. Miller is of the opinion that the pest was introduced on rose bushes imported from Chicago, Ill.

The first record of the Rose Midge in America was in 1886[1] when it was discovered to be effecting injury to greenhouse roses in the State of New Jersey. It was not until 1900, however, that the insect was described by Coquillett as *Neocerata rhodophaga*.[2] Since 1886 the midge has been reported from New York, District of Columbia, Massachusetts and Illinois.

As the Rose Midge is one of the worst known pests of roses, florists in Canada should realize the danger of its being introduced into their houses. The Entomological Branch will gladly assist growers in any way it can, and will appreciate the receipt of injured plants and information as to suspected occurrence of this insect. It has been recorded that in a single year in two greenhouses in Chicago the Rose Midge has caused damage estimated at $10,000.

Life-history.

But few observations have as yet been made in Canada on the life-history of the insect. In the State of Illinois its life-history was studied by the late F. M. Webster, and his observations were published in 1904[3]. Davis[4] has also investigated the habits of the insect.

The perfect insect, or midge, is two-winged and is closely related to the Chrysanthemum Midge. The female deposits its yellowish eggs, which are so small as to be hardly visible to the naked eye, beneath the sepals of the flower buds or between the folded leaves of the leaf buds. The egg period is recorded as being only two days. When the young, whitish, maggots hatch they at once begin to destroy the terminal leaves and the blossom buds, and in from about five to seven days they become mature and then leave the plant, (fig. 3, page 117), dropping to the soil where they change to the pupal state. Webster has observed as many as twenty-five larvæ in a single blossom bud. Davis states that in summer the fly emerges about six days after pupation occurs. In greenhouses in Chicago the insect has been present from June until October or November in such numbers as to make it impossible to secure a single crop of flowers. During the colder winter months it is assumed that the insect is present in the pupal stage in the greenhouse soil.

[1]Insect Life, 1, 284.
[2]Bull. 22, N.S., Div. of Ent., U.S., Dept. Agr., 47.
[3]Bull. Illinois State Lab. of Nat. Hist., Vol. VII, pp. 15-25.
[4]27th Rep. State Ent., Illinois, 1912.

MEANS OF CONTROL.

The question of controlling the insect has been discussed chiefly by Davis,[1] who recommended two methods: (1) the growing of another crop, such as carnations, instead of roses for one year and (2) the thorough cleaning of the house in midwinter, at which time the insects are dormant in the soil, the plants to be removed and destroyed, all earth in which they have been grown and which may contain puparia to be also removed and deeply buried at some distance from the infested houses, and further that all rubbish beneath benches be also removed and the earth, floors and benches afterwards sprayed with a contact insecticide such as kerosene emulsion.

Fumigating greenhouses with hydrocyanic acid gas will, of course, destroy the flies, but such fumigation has not proved to be a practical remedy. In an infested house it is advisable to go over the plants every day, if possible, to remove the injured buds, which should afterwards be burned.

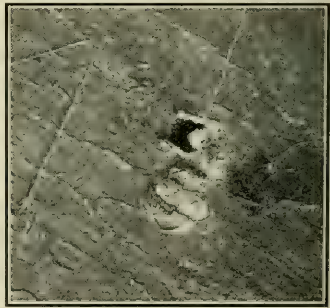
As to controlling the insect in gardens, Mr. Wood tried many methods to exterminate it but found that the only satisfactory way was to cut off all the green shoots. Such cuttings, of course, should be burned promptly.

EXPERIMENTS IN THE CONTROL OF THE POPLAR AND WILLOW BORER (*Cryptorhynchus lapathi* Linn.).

ROBERT MATHESON, ITHACA, N.Y.

The Poplar and Willow Borer is a serious pest in nurseries of New York State and at present is doing much damage. It is also a serious pest to ornamental poplars and willows, including basket willows. The most extensive depredations of this pest occur in nurseries where large blocks of these trees are grown, and in

Cryptorhynchus lapathi. Adult.



Egg puncture at side of lenticel.

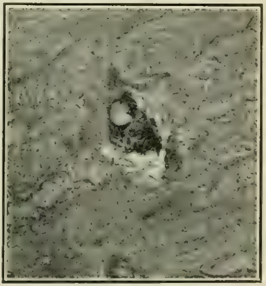
some cases the annual loss is very considerable. During the past three years, as time would permit, control experiments have been conducted in two of our large nurseries. This work has been made possible through the courtesy of the proprietors, and to them I desire to express my thanks.

[1]27th Rep. State Ent. Ill., 111.

Although considerable biological data have been gathered in the course of this work, only the control experiments and their results wil be discussed here. Since the publication of Schoene's work in Bulletin 286 of the New York Experiment Station, at Geneva, very little has been done in reference to this insect. As the result of his work he recommended the use of Bordeaux mixture containing an arsenical. This spray should be applied during late July in order to destroy the adults which feed indiscriminately on the bark of the trees. Owing to the difficulty of spraying nursery trees this recommendation has not been adopted, and I know of no experiments which have been conducted on a large scale in order to test the efficiency of this method.

To present the method of experimentation more clearly a brief synopsis of the life cycle of *C. lapathi* Linn. is necessary. The eggs are deposited in August, September and October in two or three-year-old stock in the nursery rows. I did not succeed in finding eggs in younger stock. The eggs are laid exclusively in the corky portions of the tree, just below the surface of the bark near the cambium

Egg in situ.



Larva, just hatched.

layer. They were found most commonly around lenticels, near buds and branches, or in growths caused by pruning. These eggs hatch in late August, September and October. The young grubs feed on the bark and grow slightly before hibernation. In these small chambers, just below the surface of the outer bark, the young larvæ pass the winter. Feeding begins early in the spring, the larvæ attacking the cambium layer and often girdling the trees. In late June they bore into the heart of the trees, forming the pupal cells. Pupation takes place during July and the adults begin emerging in late July and August. The beetles feed for a short time before beginning to oviposit.

Up to the time that the writer undertook work on this insect no efficient control measures had been devised. The general recommendations had been the cutting out and destruction of infested trees. Schoene in Bulletin 286 of the New York Experiment Station stated that the use of arsenicals during July and August would poison the greater majority of the beetles and reduce infestations in nurseries. In practice it has been found that though Paris green and lead arsenates were used in large quantities it had no effect in reducing the annual loss. At the time (1914) the author began to look into this problem several large nurseries in New York

State had about concluded to cease raising Carolina poplars although there was a steady demand for such stock.

Early observations led the writer to the conclusion that this insect could be destroyed by some contact spray applied to the trunks of the trees in the autumn after the leaves have fallen, or in the spring before the young larvæ have begun actively feeding. This seemed very reasonable, owing to the quite exposed condition of the young larvæ in their burrows. It seemed that some of the emulsions ought to penetrate the outer bark or be absorbed through the very small amount of frass at the entrance to the burrows and destroy them. With this conclusion, varying strengths of miscible oils and kerosene emulsion applied both in the fall and spring were experimented with. In order to secure a stronger penetrating fluid it was felt carbolineum avenarius ought to be given a thorough trial, but very little is known about the constituents of this preparation. Furthermore, very little is known as to its effects on actively growing or dormant trees.

In the fall of 1913 seventy-six badly infested two-year-old poplar trees were secured and planted at the insectary. On December 1, 1913, part of this block was treated with scalecide at varying strengths and also a few trees with carbolineum and its emulsion[1] as indicated in the table. This experiment was closely watched the following spring but no injury to the trees could be noted, except that the carbolineum treated trees did not seem so vigorous. However, they grew and are now (1916) large healthy trees. Examination and careful count of the burrows in all of the trees was made on June 17, 1914. The number of larvæ present per tree is shown in table I.

TABLE I. CRYPTORHYNCHUS LAPATHI. Linn.

Treatment	When Applied	No. Trees	Examined	No. Infested	Larvae per Tree (Average)	Not Infested	Percent. Infested
Scalecide 1-5*	Dec. 1, 1913	10	June 17, 1914	3	2.6	7	30
Scalecide 1-8	"	10	"	4	1.25	6	40
Scalecide 1-10	"	10	"	7	2.3	3	70
Scalecide 1-12	"	10	"	8	1.9	2	80
Scalecide 1-15	"	10	"	5	2	5	50
Carbolineum 1-1........	"	2	"	0	....	2	0
Carbolineum Emulsion 1-2	"	2	"	0	....	2	0
Check	"	22	"	10	2.6	12	45.5

In the spring of 1914 a series of experiments was undertaken in a large nursery. Three-year-old stock was chosen as it was the most available at the time of doing the work. Badly infested trees were selected at one side of a large block which had been recently dug. Directly across the roadway was a block of young poplars. On March 31 scalecide, of varying strengths, carbolineum, and carbolineum emulsion were applied to the trunks from the ground up to the young growth. The day was fair but it began raining before the various treatments were completed. However, the rainfall was slight so it should not have had any effect on the insecticidal qualities of the preparations.

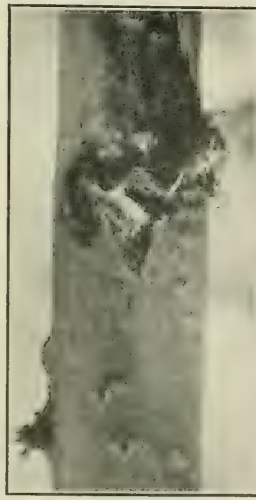
The treated trees were examined carefully on May 14, 1914. The various treatments had no effect on the growth of the trees, every tree growing vigorously,

[1]The carbolineum emulsion was prepared as follows: 1 lb. sodium carbonate, 1 quart hot water, 1 quart carbolineum avenarius. The sodium carbonate was dissolved in the hot water and the carbolineum was then added, stirring vigorously.

*All dilutions are with water.

and their being no difference as far as could be detected between the checks and those under experimentation. In the checks the larvæ were actively at work and their abundance was indicated by the amount of sawdust exuding from the numerous burrows. All the trees treated with different strengths of scalecide showed just as high a percentage of infestation as the checks. This preparation had no appreciable effect. In the trees treated with carbolineum, either pure or as an emulsion, not a trace of infestation could be found. After searching for several hours one shrivelled and blackened larva was discovered in its burrow. However, it was not desirable to injure the trees too much by cutting into all suspicious egg punctures.

The girdling work of the larvæ on nursery trees.



Showing the beginning of the formation of the pupal chamber.

This experiment was again carefully examined on June 18 and confirmed previous observations. The checks and those treated with scalecide were nearly all badly infested, many trees with as many as eight to ten borers present, while a few both in the treated and checks were apparently free. Those trees treated with carbolineum and its emulsion were growing even more vigorously than the untreated ones, and not a single trace of the work of the borer in any one of the twelve treated trees could be discovered. These preparations colored the trunks of the trees a beautiful brown, but other than that no injury could be seen.

Fearing that such a perfect control might be due to other causes than the effect of the treatment, a larger series of experiments was planned for the fall of 1914 and spring of 1915. Discarding the miscible oils, kerosene emulsion was given a trial as it has been recommended for the control of the locust borer (*Cyllene robiniæ*). In a block of over 10,000 trees ready for digging in the fall of 1915

rows were selected at the end which showed the greatest amount of the feeding work of the beetles. On December 4, 1914, groups of twenty trees were each treated with pure kerosene emulsion, carbolineum and carbolineum emulsion. Rows were left between for checks. The material was applied directly to the trunks up to the younger growth. On April 9, 1915, twenty-five trees were treated with pure kerosene emulsion, fifty with carbolineum emulsion and twenty-eight with pure carbolineum. Just previous to these treatments the trees in the whole block had

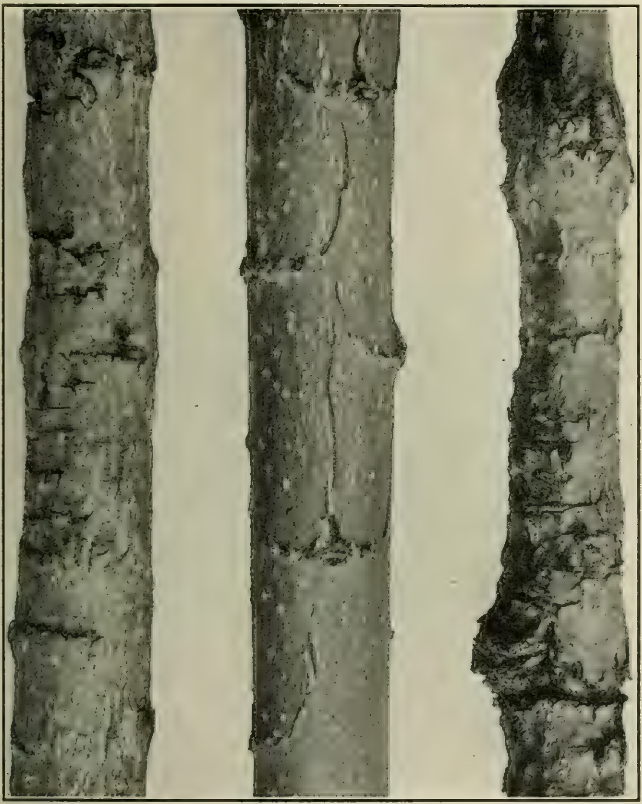
Three pupal chambers in a small 3-year old nursery tree.

Pupa in its cell.

been pruned carefully. The material was carefully brushed over the trunks, covering all the cut surfaces of the recently removed branches.

The experiment was examined on June 28. The block as a whole showed a severe infestation, sawdust being present at the base of a great many trees, and this could be seen for a long distance down the nursery rows. In the rows treated with carbolineum or its emulsion no sawdust could be seen and the trees were vigorous growers, the trunks showing a beautiful brown color but not an indication

of borer work. The kerosene emulsion had no appreciable effect, nor did it injure the trees, though it was applied in large quantities. The treatments applied and results obtained may be quickly ascertained by consulting Table II. Kerosene emulsion applied pure in the fall seems to have had some effect, but one cannot



Effects of borers on nursery stock. The tree in the centre is uninjured, and one year younger than the other two. Note the comparative size and beauty of uninjured tree.

safely draw conclusions. Thirty per cent. infestation is high, though the average number of larvæ per tree is a minimum. The carbolineum applied pure and its emulsion gave almost absolute control and seems to me a very simple and effective means of control under nursery conditions.

TABLE II. CRYPTORHYNCHUS LAPATHI, Linn.

Treatment	When Applied	No. Trees	Examined	No. Infested	Larvæ per Tree (Average)	Not Infested	Percent. Infested
Kerosene emulsion, (pure)	Dec. 4, 1914	20	June 28, 1915	6	1	14	30
" "	Apl. 9, 1915	25	"	16	2.25	9	64
Carbolineum	Dec. 4, 1914	20	"	0	....	20	0
" emulsion	Apl. 9, 1915	27	"	0	....	27	0
Carbolineum "	Dec. 4, 1914	20	"	0	....	20	0
" "	Apl. 9, 1915	50	"	0	....	50	0
Check	....	116	"	56	2.4	60	48.3

The success of the preliminary experiments led to the trial of the carbolineum treatment on a commercial scale. In the fall of 1915 arrangements were made to treat two entire blocks of poplar trees in two large nurseries. This was made

One of many piles of discarded poplars in nursery.

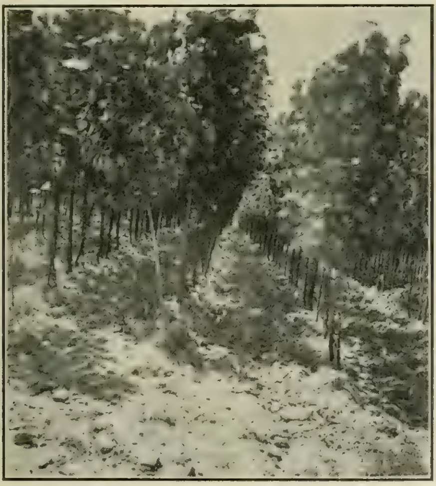
possible by the courtesy of the owners who provided all the material, help and necessary equipment, the writer taking charge of the work. Each block of trees contained approximately 14,000 trees. Owing to the excessive snowfall during the winter of 1915 and 1916 it was not possible to apply the carbolineum as early as was intended. Furthermore, it was also delayed somewhat in order that the trees should be pruned.

On April 8, 1916, 21 rows in one block were treated. As the day was cold, threatening snow and sleet, the work was discontinued. During the following day over three inches of snow fell and the remainder of the block was not treated till April 13. In the meantime the borers had begun feeding, in fact were active since about the early days of April. The results of the treatment in this block are shown in the following table:

TABLE III. CRYPTORHYNCHUS LAPATHI, Linn.

Treatment	When Applied	No. Trees	Examined	No. Infested	Larvæ per tree	Not Infested	Per cent. Infested
Carbolineum	Apl. 18, 1916	5,000	June 22, 1916	0*	0	1,161	0
	" 13, "	9,000	July 20, "	1	1	1,160	....
Creosote........	" 8, "	136	June 22, "	0	0	136	0
			July 20, "	0	0	136	0
Check	....	313	June 22, "	9	2	304	2.9
			July 20, "	11	2	302	3.5

It will be seen from the above table that practically absolute control was secured with the carbolineum treatment. Unfortunately, the entire check row did not show a high percentage of infestation, but it is sufficient to indicate that the treatment was effective. In addition to the carbolineum a high grade creosote was



Showing treated row on each side of a check. Note the almost black color of the treated rows.

also tried in a limited way. The creosote also gave perfect control and this indicates well, for the row treated stood directly next the check row. The carbolineum gave the bark of the trees a beautiful brown appearance, but it in no way affected the vigor of the trees. This brownish coloration gradually becomes reduced during the summer, but treated trees can be recognized easily at least three

*In order to determine the infestation in the treated trees not all of the 14,000 trees were examined. Rows were selected, however, in different parts of the block and every tree examined carefully. In this way, 1,161 trees were closely scrutinized and not a sign of borer work could be found. Based on the result of this examination the figures in the table have been prepared. In the second examination a single larva was found at work on one of the treated trees, but as this was the *rare* exception the fact has been ignored in the percentage column.

years afterwards. Another point that should be brought out here is that the four trees treated with carbolineum in my experimental plot in 1913 (Dec. 1, 1913), were not attacked during the summers of 1914 and 1915 and only a single larva was found in them during 1916. This would indicate that carbolineum treated trees are not readily selected by the females for oviposition, provided untreated trees are available. This point will be further investigated by the writer.

The results of the treatment of the second block of about an equal number of trees are shown in the following table.

TABLE IV. CRYPTORHYNCHUS LAPATHI, Linn.

Treatment	When Applied	No. Trees	Examined	No. Infested	Larvæ per Tree	Not Infested	Per cent. Infested
Carbolineum....	Apl. 12 & 13, 1916	14,000	June 23, 1916	20	1,4	1,540*	1.28
			July 20, "	20	1.4	1,540	1.28
Check	....	84	June 23, "	8	1	76	9.5
			July 20, "	8	1	76	9.5
Check	....	555	June 23, "	19	1.2	536	3.42
			July 20, "	19	1.2	536	3.42

In this block we have extremely interesting results showing most conclusively the effectiveness of the carbolineum treatment. The author visited this nursery and showed the owner the method of treatment, but did not further supervise the work. In treating the trees the following day the workman failed in many cases to cover the base of the trees with the material, and also failed to apply it sufficiently high on the trunk. As a result all of the infestations, amounting to nearly 1.3 per cent., occurred either at the base or above the highest point of treatment. Another interesting point is in regard to the check row. This row running through the centre of the block contained 639 trees. When the owner saw the excellent results in the treated trees he thought why should he not save most of the check row. So on June 3, 4 or 5, he did not know the exact date, he treated 555 of the trees, leaving some at either end as a true check. The treatment, even at this late date, had a marked effect as shown by the percentage of infestation as found on June 23. During the first week in June all of the larvæ were still at work in the cambium layer and wherever sufficient material was applied most of the larvæ were killed. The trees then readily outgrew the injury. The carbolineum had no apparent effect in the retardation of growth.

METHOD OF APPLICATION.

After many trials it was found that the simplest method of application was by the use of cotton waste. The carbolineum is non-injurious to the hands so each workman carried a small amount of the material in a dipper or tin can. The cotton waste was dipped into the material and then rubbed carefully up and down the trunk. It is not necessary usually to go higher than four or five feet, but great care should be exercised to see that the base of the tree is well treated and all parts of the trunk well covered. At the same time the material should not be allowed to run down to the roots. After the trees are pruned workmen can apply the material at a very rapid rate. It is preferable to make the application on a warm day as the carbolineum is then thinner and more easily put on the trees.

*Only 1,560 trees were examined, but these were selected rows and the percentage of infestation is fairly accurate.

Cost of Treatment.

It was at first thought that the cost of treatment might prevent its use under nursery conditions inasmuch as poplars are not very high priced stock. In one nursery a careful account of the entire cost of treatment was kept and is shown below.

Labor to treat 14,000 trees	$18 50
Material, carbolineum, 7 gals at 90c.	6 30
Total cost	$24 80
Total cost per tree	0.00177

It will thus be seen that the cost per tree is extremely small, not exceeding two-tenths of a cent, a practically negligible charge.

Note work of borer just where treatment with carbolineum ends. Shown by arrow.

Carbolineum treatment ends at arrow point A. Note the two borers near base of the tree.

Summary.

The poplar and willow borer is a serious pest in restricting the production of Carolina poplars in our nurseries. Many nurseries have either given up raising them or are planning to do so.

The trees attacked by this beetle include a wide variety of poplars (*Populus spp.*) and willows (*Salix spp.*). The trees are valuable both as ornamental, shade and forest trees and the depredations of this insect are sometimes serious.

Almost perfect control was secured by treating the trunk of infested trees, under nursery conditions, with carbolineum. The material is inexpensive and easily applied.

The writer does not see any reason why this treatment could not be extended to include willows and experiments will be undertaken with this end in view. Furthermore, if persons who purchase poplars or willows will have them treated at the time of planting the spread of the insect should be greatly checked, and at the same time save the trees.

THE FRUIT-TREE LEAF-ROLLER IN NEW YORK STATE.

GLENN W. HERRICK, ITHACA, N.Y.

Because of its varied agricultural and horticultural interests, because of its nearness to the seaboard and the consequent importation and landing of many and various plants and agricultural products, and because it stands in the path of the great carriers to the Western States, New York is especially subject to outbreaks

Larva of the leaf-roller.

of both old and new insect pests and plant diseases. This is true more especially perhaps of those affecting the horticultural interests of the State. Nearly every season witnesses an outbreak of some old pest which has suddenly gained a new foothold, and has taken on new energy or of some foreign importation that has been dropped by the way or been established by the bringing in of new plants or plant products. To the entomologist New York State furnishes a field of perennial interest, but to the horticulturist one of perennial fight and struggle.

Because of the proximity of the principal fruit districts of the State to those of Ontario, Canada, whatever is of interest in the way of insect pests here is also of considerable interest to Ontario entomologists and fruit growers. It was with this thought in mind that the writer chose to discuss briefly the fruit tree leaf-roller in New York.

This leaf-roller is not an insect new to this country for it has been known since 1863 when Walker described it and since 1896, at least, it has been put among the enemies of the apple in New York. It was not, however, until 1911 that the leaf-roller began to attract particular attention in this State. It furnishes a fine example of an insect previously unimportant which has suddenly and inexplicably multiplied to an enormous degree and reached the rank of a serious pest at a single bound, for during the seasons of 1912, 1913, 1914, and 1915, it caused serious and rather widespread injury in Western New York. In addition, it became unusually abundant and injurious in Colorado and New Mexico during the same period. During the past season it was much less in evidence but no prediction can be made regarding it for it may break out again at any favorable time.

Habits and Injuries.

The larvæ appear as the buds are bursting and begin to attack the unfolding leaves. They bend the leaves over and tie them together with silk. Within this sort of nest the larvæ live and eat the leaves. As soon as the blooms

Leaves tied together by the leaf-roller.

Work of leaf-roller on pears.

appear the larvæ begin to eat off the blossom stems and tie them together with silken threads, along with the leaves surrounding the blossom cluster. This webbing and tying together of the blossom clusters is a most pernicious habit, because it interferes seriously with spraying for the Codling Moth. In one Baldwin orchard in which the larvæ were very abundant, the blossom clusters were so webbed together and covered over with silk, dried petals and leaves that it was almost impossible to get the spray mixture into the calyx cup. As soon as the young apples or pears begin to set they are tied together with silk, while the larvæ

live inside and gnaw cavities into the sides of the young fruit. Dr. Lintner reports the same habit of the larvæ and refers to some young pears that were eaten into, sent to him by P. Barry, of Rochester, in 1888. Stedman mentions the same kind of injury in Missouri and considers this the most serious form of injury committed by the insect. To give some idea of the number of larvæ present the writer counted 17 worms in nine blossom clusters; Braucher counted 21 larvæ on one twig 21 inches long, and 19 larvæ on another twig 22 inches long.

The larvæ also work on the leaves, rolling them and living within the roll. Here, effectually hidden, they feed on the tender tissues of the leaves. When disturbed they drop down out of their hiding places and remain suspended by silken threads like cankerworms. When all is quiet they climb back to their hiding places and begin their work again. Their injuries to the leaves are often very serious, especially when the larvæ are abundant. Gillette says, "I have seen small orchards entirely defoliated by this species so that not a green leaf could be seen."

Life-History.

Our observations accord with those of other workers for we find but one generation each year in New York.

The eggs are deposited in greatest numbers during the last of June and the first part of July. They are laid in small, oval, convex patches about as large as the end of a lead pencil on the bark of the smaller twigs. Here they remain until the following May or for a period of about ten months.

The hatching period extends over an interval of two or three weeks although the majority of the larvæ appear about the time the buds are bursting.

The full grown larva is about one inch in length, light green in color, with a black head, and black thoracic shield. It takes from three to four weeks for the larva to become full grown. It pupates in a flimsy web in a rolled leaf and in about twelve days the adult moths appear. These soon begin to deposit their eggs thus completing the life cycle.

Natural Enemies.

The fruit-tree leaf-roller seems to have a number of natural enemies. We bred at least four species of hymenopterous parasites from the larvæ and pupæ in our cages. Gill has recorded several species of birds feeding on the larvæ and has also found a few insects which are predaceous on the leaf-roller; notwithstanding this rather large list of enemies the leaf-roller has not been held in check but in spite of them has increased enormously at certain periods.

Methods of Control.

The leaf-roller has been one of the most difficult of lepidopterous apple pests to control. Its habit of rolling leaves, tying them together, and living within these protective coverings makes it difficult to get at. Attempts were made to control the insect by thoroughly spraying the infested trees with arsenate of lead and lime-sulphur about the time the buds were bursting, and again just before the blossoms opened, but the results were not satisfactory.

In the spring of 1911 a badly infested orchard in western New York was thoroughly sprayed, as the buds were bursting with 2 pounds of arsenate of lead

to 50 gallons of lime-sulphur solution. On May 13th just before the blossoms opened 13 Baldwin trees in this orchard were sprayed again with arsenate of lead, 2 pounds to 50 gallons of lime-sulphur and 200 gallons of the mixture were put on the 13 trees. Later, after the petals had fallen, the regular codling moth spray was given to these trees thus making three thorough poison sprays. We were much disappointed to find that the number of larvæ was not visibly lessened by these applications.

In the spring of 1912 we projected and carried out an extensive series of experiments in the control of this pest. Mixtures of paste arsenate of lead, arsenite of zinc, black-leaf-40 and soap, and powdered arsenate of lead in different combinations and proportions were tried on various blocks of badly infested trees, principally Greenings. In all, over seventeen combinations of materials were tried on different groups of trees in the orchard. Most of the applications were made before the cluster of flower buds had separated. At this time, however, a large part of the eggs had hatched and many larvæ had already worked their way down among the cluster buds and were feeding on the buds and bud stems.

The results of the whole series of experiments were really very discouraging so far as prevention of injury to the fruit was concerned. There was so little difference between the sprayed and unsprayed portions that it did not seem worth while to make a count of the fruit. The orchard produced only about two hundred and fifty barrels of apples out of a normal eight hundred barrels, and these were mostly in the tops of the trees and in portions of the orchard not so badly infested. In this connection the work of one of the better and more intelligent fruit growers in New York is of interest.

The large orchards of this fruit grower were sprayed five times and sprayed thoroughly and intelligently. The orchards were sprayed first, in the dormant condition, just before the buds burst, with lime-sulphur, 1 gallon to 6½ gallons of water with 1 pint of black-leaf-40 to every 100 gallons for the aphis. The second spraying was made just before the blossoms opened with lime-sulphur 1 to 50 and 3 pounds of arsenate of lead. The third application was made just as the petals had fallen and consisted of lime-sulphur 1 to 50, arsenate of lead 3 pounds and black-leaf-40, ¾ pint to 100 gallons. A fourth spraying was made about ten days to two weeks after the third with lime-sulphur 1 to 50 and 3 pounds of arsenate of lead. At about this time the owners became much worried over the roller and sprayed a fifth time with arsenate of lead alone, 4 pounds to 50 gallons. In spite of this extraordinary amount of careful and thorough spraying the trees and cover crop under the trees were alive with larvæ and 40 per cent. of the crop was ruined.

During the season of 1914 careful experiments were conducted again with the poison sprays in western New York but with indifferent results. To sum up, thorough spraying with arsenate of lead in heavy proportions has not proved effective in cases of severe infestation either in New York or in the western States.

In 1914 the writer and Mr. R. W. Leiby carried out an extensive series of experiments in the field at Hilton, New York. The writer had determined by laboratory experiments made in 1912 that the miscible oils were very effective in destroying the eggs. In 1913 some limited orchard experiments demonstrated the effectiveness of these oils under field conditions and in 1914 we determined to try them on a much larger scale. In these experiments we used Scalecide, Orchard Brand, and Target Brand miscible oils. Suffice it to say, without going into details, that the miscible oils gave very gratifying results. We were able to destroy from 74 to 92 per cent. of the eggs and we believe that these oils furnish

a means of control for the leaf-roller if they are intelligently and thoroughly applied. Such has also been the experience and conclusion of Gill in Colorado, Childs of Oregon, and Weldon, in Colorado and California.

Conclusions and Recommendations.

The leaf-roller is difficult to control because of its habit of hiding in the opening buds or in rolled leaves. Thorough spraying with arsenate of lead in heavy proportions has not proved effective in cases of severe infestation, either in New York or in the Western States.

Extended experiments show that the eggs of the leaf-roller are susceptible to the effect of miscible oils, which, when thoroughly applied, have destroyed from 74 to 92 per cent. of the eggs. In Colorado, New Mexico, and Oregon, where these oils have also been used extensively, even a higher proportion of the eggs have been destroyed. In experiments made during the last three years no injury has resulted from the use of miscible oils. The oils have been applied in the spring (April) at as near the active growing period of the tree as possible, but always before the buds burst. They have been used generally at the rate of 1 gallon to 15 gallons of water. Only one application should be made and that on a day when the temperature is above freezing.

In cases of severe infestation the oils should be supplemented by thorough sprayings with arsenate of lead at the rate of 6 pounds to 100 gallons of water or of lime-sulphur solution. At least one application should be made before the blossoms open, and another after the petals fall: the latter will serve also as the regular spraying for Codling Moth. In lightly infested orchards spraying with miscible oils may be omitted and reliance placed on thorough applications of arsenate of lead, at the rate of 6 pounds to 100 gallons of water or lime-sulphur solution. One or two applications should be made before the blossoms open and another after the petals fall.

Dr. Hewitt: It is always a very pleasurable duty at the conclusion of these meetings to thank our hosts, and I have much pleasure, therefore, in moving that the very hearty thanks of the Society be tendered to the President of the College and his staff for the generous hospitality which has been extended to the Society, both in providing for the meeting place for the Society and for our entertainment in the dining hall, and to the President of the Students' Council who so kindly added to the social enjoyment of the members. I think I am voicing the sentiments of all the members who are present when I say that this meeting has been extremely enjoyable from the social point of view from the fact that we have been permitted to lunch in the dining hall—which I may say we hope is a custom which will be continued in future years. It has added greatly to the convenience of the meeting, and to the opportunity of different members meeting each other, and also for the very enjoyable entertainment last night which was afforded us. May I also say how gratifying it is to the visiting members to find Dr. Bethune in such excellent health and still carrying on his work. It is a great pleasure to have him still taking an active part in the meetings, and I hope that pleasure will be continued for many years to come.

Prof. Lochhead: I should like to second that motion proposed by Dr. Hewitt. I have especially enjoyed my visit here. I have looked forward to it for some time, and it is like coming home again to come back here and meet old friends. Of course the student body is different from my time, but there are a sufficient number of familiar faces left to remind me of my old days here. I am

very much pleased also to see Dr. Bethune so hale and hearty. I hope he will have many years yet of pleasant work among his beloved insects and also among his beloved students. I have to thank, also, especially Mr. Baker and Mr. Caesar for the untiring efforts they have put forth for our welfare, and for the programme they have got together.

THE ENTOMOLOGICAL RECORD, 1916.

ARTHUR GIBSON, CHIEF ASSISTANT ENTOMOLOGIST, DEPARTMENT OF AGRICULTURE, OTTAWA.

Although the season of 1916 was disappointing, on the whole, for entomological work in general in Canada, there was accomplished, nevertheless, throughout the Dominion, much careful collecting in the various orders of insects. During the early part of the season, cool and rainy weather interfered considerably with such work, and later, in July and August, exceptionally high temperatures were recorded.

In June eastern entomologists had the pleasure of meeting Mr. J. H. Emerton, of Boston, Mass., and Dr. W. T. M. Forbes, of Worcester, Mass., both of whom visited together various districts in the Provinces of Ontario and Quebec. The former collected spiders, and the latter insects in general, but chiefly lepidoptera. Mr. C. H. Young, of the Geological Survey, collected in the district of Lillooet, B.C. Other officers of the Geological Survey, also brought back small collections from distant fields. The insects collected in the far north in the years 1913 and 1914, by Mr. Frits Johansen, while with the Southern Scientific party of the Canadian Arctic Expedition, are now in Ottawa, and are being mounted for immediate study.

It is again our pleasant duty to acknowledge the many favors we have received from specialists in the United States and elsewhere. Our special thanks are due to Dr. L. O. Howard, and his colleagues at Washington—Messrs. Crawford, Busck, Schwarz, Banks, Gahan, Knab and Dr. Dyar; Sir George Hampson, of the British Museum; Dr. J. M. Aldrich, of La Fayette, Ind.; Mr. C. W. Johnson, of Boston, Mass.; Col. Thos. L. Casey, of Washington, D.C.; Prof. H. F. Wickham, of Iowa City, Iowa; Mr. E. P. Van Duzee, of Berkeley, Cal.; Dr. Henry Skinner, of Philadelphia, Pa.; Mr. Chas. Liebeck, of Philadelphia, Pa.; Prof. H. S. Hine, of Columbus, Ohio; Mr. Chas. W. Leng, of New York, N.Y.; Dr. W. G. Dietz, of Hazleton, Pa.; Dr. F. C. Fall, of Pasadena, Cal.; Mr. M. C. Van Duzee, of Buffalo, N.Y.; Mr. C. A. Frost, of South Framingham, Mass.; Dr. E. C. Van Dyke, of Berkeley, Cal.; Mr. J. H. Emerton, of Boston, Mass.; Messrs. Barnes and McDunnough, Decatur, Ill.; Mr. F. H. Wolley-Dod, of Midnapore, Alta., and Dr. E. M. Walker, of Toronto, Ont.

LITERATURE.

Among the books memoirs, etc., which have appeared during 1916, and which are of interest to Canadian students, the following should be mentioned:

ALDRICH, J. M. Sarcophaga and Allies in North America: The Thomas Say Foundation of the Entomological Society of America: La Fayette, Indiana, U.S., date of issue Nov. 30, 1916. The Sarcophagid flies are interesting insects ranging in larval habit from scavengers to parasites of warm blooded animals. Dr.

Aldrich's study of the various species, comprising 301 pages, will be welcomed by entomologists generally. Sixteen plates at the end of the volume illustrate genital characters. Ninety-five species are described as new, five of which are from Canada, and five as new varieties, one of which is Canadian.

BARNES, W., AND McDUNNOUGH, J. Check List of the Lepidoptera of North America: Decatur, Ill., price $2.00. The appearance of this new check list which has been eagerly awaited by lepidopterists, was an exceedingly welcome one. The authors have our hearty congratulations on the completion of such an arduous task. The classification of the species is considerably different from that in Dyar's catalogue, which most collectors have been using. The arrangement of the text matter is similar to that in Smith's 1903 check list, which it replaces. The new list comprises 197 pages.

BLATCHLEY, W. S. AND LENG, C. W. Rhynchophora or Weevils of North Eastern America: Nature Publishing Co., Indianapolis, Ind.; 1916, 682 pages, 150 text figures, price $4.00 unbound. Like the work of the senior author, the "Coleoptera or Beetles of Indiana," published in 1910, this work on the Rhynchophora, will prove of inestimable value to entomologists generally. With this new manual in hand, students will now be able to arrange, classify and determine the scientific names of the weevils in their collections. Keys to the families, subfamilies, tribes, genera and species have been made an important part of the present work. Following the descriptions of each species are notes on distribution, food habits, etc. The classification used is mainly that of LeConte & Horn (1876) modified where necessary by the recent studies of Casey, Hopkins, Pierce and certain European authors. A bibliography at the end notes the various works on Rhynchophora, which have been consulted in the preparation of the volume.

CASEY, THOS. L. Memoirs on the Coleoptera, VII; issued Nov. 29, 1916; The New Era Printing Co., Lancaster, Pa. This contribution of 300 pages is divided into two parts, namely: I—Further Studies in the Cicindelidæ, and II—Some Random Studies Among the Clavicornia. In the former pages 1 to 35, eleven new species are described, one of which is from Hudson Bay Territory, and thirty-three new sub-species none of which are from Canada. In part II, a large number of new species are described, only three of which, however, are from Canada.

FELT, E. P. A Study of Gall Midges, III: New York State Museum Bulletin No. 180, pp. 127-288, issued Jan. 1, 1916. In this important contribution the species of the tribes Porricondylariæ and Oligotrophiariæ are discussed, several of which are described as new. Descriptions of nine species known to occur in Canada are given. In addition to 101 text figures, 16 plates accompany the memoir, showing gall midge wings, genitalia and galls.

In the 31st Report of the State Entomologist of New York, (June 1, 1916), the same author contributes: "A Study of Gall Midges, IV, pp. 101-172, the Tribe Asphondyliariæ being monographed. Thirty-nine text figures are included.

FERRIS, G. F. A catalogue and host list of the Anoplura: Proc. Cal. Acad. Sci. Vol. VI, No. 6, pp. 129-213, May 12, 1916. This publication will doubtless be a welcome one to those interested in the sucking lice. Following a key to the families, sub-families and genera, the species are listed with the names of the animals upon which they have been found. Before listing the recognized species in each genus, the author describes the important generic characters. The catalogue is complete to April, 1916.

METCALF, C. L. Syrphidæ of Maine: Maine Agric. Exp. Station, Bull. No.

253, pp. 193-264, 9 plates, issued Oct. 14, 1916. This bulletin will undoubtedly prove of much value to Canadian dipterists, particularly those residing in the eastern provinces. Not only are descriptions of the more important or interesting Maine species given, but artificial keys to the larvæ and pupæ of the syrphidæ are also presented. Interesting chapters on the habits, structure and economic importance of the larvæ, etc., are included. The plates illustrate the life-stages of ten different species.

Mosher, Edna. A classification of the Lepidoptera based on characters of the pupa: Bull, of the Ill. State Lab. of Nat. History, Vol. XII, Article II, March, 1916, pp. 17-159, plates XIX to XXVII. In 1895, Packard published a paper entitled "Attempt at a New Classification of the Lepidoptera," based upon pupal characters. The determinations of the homology of the various parts of the pupæ were, it is stated by the above author, far from correct, and this, of course, invalidated many of his conclusions. Since Packard's paper, nothing has appeared in America towards such a classification until Dr. Mosher's contribution. Following the introduction are chapters on "Changes Preceding Pupation," and "External Morphology," under which is discussed in detail the head, the thorax and the abdomen. In the "classification" keys to many of the families are given, and plates XIX to XXVII illustrate valuable characters. The memoir is, indeed, an important one, and the author is to be congratulated on the completion of so useful a study.

Needham, James G. and Lloyd, J. T. The Life of Inland Waters, an elementary text book of fresh-water biology for American students: The Comstock Publishing Co., Ithaca, N.Y., 1916; 438 pages, 244 text figures; price $3.00. This book is divided into seven chapters: I, Introduction; II, The Nature of Aquatic Environment; III, Types of Aquatic Environment; IV, Aquatic Organisms; V, Adjustment to Conditions of Aquatic Life; VI, Aquatic Societies; VII, Inland Water Culture. Chapters IV, V and VI, contains much entomological matter.

Osborn, Herbert. Agricultural Entomology, for students, farmers, fruit-growers and gardeners: Lea & Febiger, Philadelphia and New York, 1916; 347 pages, 252 text figures, 1 colored plate. This book, the author states, has been designed to meet the needs of students and others who wish to learn something of insect life, especially in relation to farm crops and live stock. It will undoubtedly prove a useful work of reference.

Osborn, Herbert and Drake, Carl J. The Tingitoidea of Ohio: Ohio State University Bulletin, Vol. XX, No. 35, pp. 217-251. This study of these insects of Ohio commonly known as "lace-bugs" will be of interest to Canadian students. Ten new species are described. Nine figures occur in the text in addition to which there are two plates.

Van Duzee, Edward P. Check List of the Hemiptera (excepting the Aphididæ, Aleurodidæ and Coccidæ of America, north of Mexico, p. 111: New York Entomological Society, 1916. The appearance of this long-looked for check list was, I feel sure, welcomed by entomologists generally. In the preface the author states that "the present Check List has been drawn off from a complete bibliographical and synonymical catalogue of the Hemiptera of America North of Mexico, which was completed last winter, and later will be published by the University of California Press. Except for the references to the literature of the subjects, this Check List gives most of the information in the large catalogue and includes the systematic arrangements, full synonymy, the date of each name, and roughly the distribution of each species." Copies of the Check List may be obtained

from the Treasurer of the New York Entomological Society, the price of the same is $1.50.

VAN DUZEE, E. P. Monograph of the North American Species of Orthotylus (Hemiptera): Proc. Cal. Acad. Sci., Vol. VI, No. 5, pp. 87-128, May 8, 1916. In this paper the author includes the species recorded from America, north of Mexico. Twenty-five species are described as new, one of which is from Canada. One plate showing male genital hooks accompanies the paper.

COLLECTORS.

The following is a list of the names and addresses of collectors heard from during 1916:

Anderson, E. M., Provincial Museum, Victoria, B.C.
Baird, Thos., High River, Alta.
Beaulieu, G., Ent. Branch, Dept. Agr., Ottawa.
Beaulne, J. I., Ent. Branch, Dept. Agr. Ottawa.
Bethune, Rev. Prof., O.A.C., Guelph.
Blackmore, E. H., Victoria, B.C.
Bowman, K., 9914-115th Street, Edmonton, Alta.
Brimley, J. F., Wellington, Ont.
Brittain, W., Agric. College, Truro, N.S.
Caesar, L., O.A.C., Guelph, Ont.
Carr, F. S., Edmonton, Alta.
Chagnon, Gus., Box 521, Montreal.
Chagnon, W., St. John's, Que.
Chrystal, R. N., Ent. Branch, Dept. Agr., Ottawa.
Cockle, J. W., Kaslo, B.C.
Cosens, Dr. A., Parkdale Collegiate Institute, Toronto.
Crew, R. J., 561 Carlaw Ave., Toronto.
Criddle, Evelyn, Aweme, Man.
Criddle, Norman, Aweme, Man.
Dawson, Horace, Hymers, Ont.
Day, G. O., Duncan, B.C.
Dod, F. H. Wolley-, Midnapore, Alta.
Dunlop, James, Woodstock, Ont.
Emile, Rev. Bro., Longueuil, Que.
Evans, J. D., Trenton, Ont.
Fyles, Rev. Dr. T. W. 268 Frank St., Ottawa.
Germain, Rev. Bro., Three Rivers, Que.
Gibson, Arthur, Ent. Branch, Dept. Agric., Ottawa.
Hadwen, Dr. S., Agassiz, B.C.
Hahn, Paul, 433 Indian Road, Toronto.
Hanham, A. W., Duncan, B.C.
Harrington, W. H. 295 Gilmour St., Ottawa.
Hewitt, Dr. C. Gordon, Ent. Branch, Dept. Agric., Ottawa.
Holmes, James G., Westmount, Que.
Hudson, A. F., Millarville, Alta.
Johnson, Geo. S., Moose Jaw, Sask.
Kitto, V., Inland Revenue, Dept. Interior, Ottawa.
Leavitt, A. G., St. John, N.B.
Macnamara Chas., Arnprior, Ont.

Mackie, Donald, Edmonton, Alta.
McIntosh, W., St. John, N.B.
Mignault, Rev. J. B., Saint Lambert, Que.
Moore, G. A., 359 Querbes Ave., Outremont, Montreal.
Payne, H. G., Granville Ferry, N.S.
Perrin, Jos., McNab's Island, Halifax, N.S.
Petch, C. E., Hemmingford, Que.
Phair, A. W. H., Lillooet, B.C.
Ruhmann, Max M., Vernon, B.C.
Roberts, H. L., Winnipeg, Man..
Ross, W. A,. Vineland Station, Ont.
Roy, Henri, Quebec, Que.
Sanders, G. E., Annapolis, N.S.
Sanson, N. B., Banff, Alta.
Simpson, W., Dominion Observatory, Ottawa.
Simms, H. M., 192 Ontario East, Montreal.
Sladen, F. W. L., Experimental Farm, Ottawa.
Strickland, E. H., Experimental Station, Lethbridge. Alta.
Swaine, J. M., Ent. Branch, Dept. Agric., Ottawa.
Tams, W. H. T., Midnapore, Alta.
Taverner, P. A., Victoria Memorial Museum, Ottawa.
Tothill, J. D., Fredericton, N.B.
Treherne, R. C., Agassiz, B.C.
Venables, E. P., Vernon, B.C.
Walker, Dr. E. M., Univ. of Toronto, Toronto.
Wallis, J. B., 265 Langside St., Winnipeg, Man.
Whitehouse F. C., Red Deer, Alta.
Willing, Prof. T. N., Univ. of Saskatchewan, Saskatoon, Sask.
Wilson, Tom, 1105 Broadway, Vancouver, B.C.
Winn, A. F., 32 Springfield Ave., Westmount, Que.
Young, C. H., Victoria Memorial Museum, Ottawa.

NOTES OF CAPTURES.

(Species preceded by an asterisk (*) described during 1916.)

Lepidoptera.

(Arranged according to Barnes & McDunnough's Check List of the Lepidoptera of North America.)

Papilionidæ.

5. *Papilio bairdi* Edw. Red Deer, Alta., June 24, 1916, (Whitehouse).

Satyridæ.

120. *Oeneis macouni* Edw. Victoria Beach, Man., July 1, 1916, (Duthie).

Nymphalidæ.

189. **Brenthis aphirape dawsoni* B. & McD. Hymers, Ont., June 15-30, (Dawson); Can. Ent., XLVIII, 222.

193. *Brenthis chariclea grandis* B. & McD. Hymers, Ont., Aug. 1-15, (Dawson); Can. Ent., XLVIII, 222.

202. *Brenthis astarte* D. & H. Lillooet, B.C., (Phair).

305. **Basilarchia arthemis rubrofasciata* B. & McD. Province of Saskatchewan, (Croker); Cartwright, Man.; Calgary, (Dod); Can. Ent., XLVIII, 221.

Hesperiidæ.

Andopea (Pamphila) lineola. Mr. W. E. Saunders, of London, Ont., has informed me that this European species has been found at London, Ont., as follows: July 21, 1910, (10 specimens taken), 1911, (2 specimens taken). Since, taken every year, the name of the collector being Mr. John A. Morden. The determination, Mr. Saunders tells me, was made at Washington.

Sphingidæ.

696. *Sphinx drupiferarum* A. & S. Red Deer, Alta., June 28, 1916, (Whitehouse).

733. *Hæmorrhagia gracilis* G. & R. Petawawa, Ont., June 10, 1910, (record sent by A. F. Winn from specimen in collection of G. A. Southee, Outremont, Que.).

Saturniidæ.

785. **Hemileuca lucina latifascia* B. & McD. Aweme, Man., Sept., (N. Criddle); Can. Ent., XLVIII, 224.

Arctiidæ.

973. *Apantesis parthenice* Kirby. Stellarton, N.S., (C. B. Hills). First record I have for the Province, (A. G.).

982. *Apantesis virguncula* Kirby. Stellarton, N.S., (C. B. Hills). First record I have for the Province, (A. G.).

989. *Apantesis phyllira* Dru. Wellington, Ont., July, (record sent by J. D. Evans). Furthest eastern record for Ontario, (A. G.).

1033. *Haploa lecontei militaris* Harr. Stellarton, N.S., July (C. B. Hills). First record we have for the Province, (A. G.).

1031. *Haploa confusa* Lyman. Stellarton, N.S., July 19, (C. B. Hills). First record we have for the Province, (A. G.).

Noctuidæ.

1211. **Copablepharon viridisparsa* Dod. Lethbridge, Alta., July 20, 1915, (Strickland); Calgary, Alta., Aug. 7, 1902, (Willing); Can. Ent., XLVIII, 60. The species is the No. 385 of Dod's Alberta list, originally recorded as *absidum*.

1379. **Euxoa thanatologia perfida* Dod. Calgary, Alta., (Dod); High River, Alta., (Baird); Miniota, Man., (Dennis); Kaslo, B.C., (Cockle). Can. Ent., XLVIII, 64. This is the moth referred to under No. 224, in Dod's Alberta list.

1409. *Feltia volubilis* Harv. Duncan, B.C., June 3, 1916. New to local list, (Hanham).

1718. *Polia goodelli* Grt. Murray Bay, Que., (Holmes). Only one locality—St. Hilaire—in Winn's list of Quebec lepidoptera.

1887. *Xylomiges dolosa* Grt. Edmonton, Alta., April 17, 1915; April 27, 1916, (Mackie). New to Alberta, (Dod).

2001. **Cucullia omissa* Dod. Head of Pine Creek, near Calgary, Alta., May 18, June 25-Aug. 13, (Dod); Windermere, B.C., June 12, 1907, (Dod); Nelson, B.C., (H. Cane); Aweme, Man., June 6-14, (N. Criddle); Cartwright, Man., (Heath); Hymers, Ont., July 11, 1912, (Dawson); Can. Ent., XLVIII, 58.

2116. *Epidemas melanographa* Hamp. Quamachan Lake, B.C., Oct. 10, 1910; Victoria, B.C., end of Aug., 1916, (Hanham).

2261. *Septis plutonia* Grt. Edmonton, Alta., July, 1915 and 1916, (Mackie). New to Alberta list, (Dod).

2295. *Trachea adnixa* Grt. Duncan, B.C., July, (Hanham).

2390. *Callopistria floridensis* Gn. This insect, the caterpillar of which has appeared in greenhouses in destructive numbers at Weston, near Toronto, Ont., and Montreal West, Que., is a new addition to the Canadian list. Moths from the former locality have been reared at Ottawa, (Gibson).

2440. *Acronycta fragilis* Gn. Edmonton, Alta., May 20-June 23, 1915, (Mackie). New to Alberta list, (Dod).

2441. *Acronycta minella* Dyar. Starblanket, Sask., (H. Hutchinson).

2476. *Acronycta felina cyanescens* Hamp. Victoria, B.C., July 10, 1916, (Hanham).

2497. *Acronycta distans dolorosa* Dyar. Quamichan Lake, B.C., July 29, 1914, (Hanham).

2508. *Acronycta oblinita* A. & S. Edmonton, Alta., April 30-June 15, 1914, (Mackie). New to Alberta list, (Dod).

2528. *Andropolia maxima* Dyar. Victoria, B.C., July, (Hanham).

2613. *Menopsimus caducus* Dyar. Ottawa, Ont., July 13, 1905, (Young).

2651. *Gortyna perobliqua* Hamp. Edmonton, Alta., Aug. 22, 1913, (Mackie). New to Alberta list, (Dod).

2695. *Papaipema frigida* Sm. Edmonton, Alta., Aug. 31, 1915, Sept. 3, 1916, (Mackie). New to Alberta list, (Dod).

3069. *Catocala semirelicta* Grt. Murray Bay, Que., (Holmes). In Winn's list of Quebec lepidoptera, Montreal is the only locality mentioned.

3211. *Panthea furcilla* Pack. Stellarton, N.S., (C. B. Hills). First record we have for the Province. (A. G.). Murray Bay, Que., (Holmes). Previously recorded from Gaspe and Levis in Quebec Province.

3280. *Eosphoropteryx thyatyroides* Gn. Edmonton, Alta., July 23, 1912, Aug. 12, 1916, (Mackie). New to Alberta list, (Dod).

3398. *Calpe canadensis* Beth. Stellarton, N.S., (C. B. Hills). First record we have for the Province, (A. G.).

Notodontidæ.

3611. *Odontosia elegans* Stkr. Edmonton, Alta., July 5, 1916, (Bowman).

Drepanidæ.

3761. *Drepana bilineata* Pack. Edmonton, Alta., May 12, 1915, (Mackie). New to Alberta list, (Dod).

Geometridæ.

3981. *Lygris destinata triangulata* Pack. Edmonton, Alta., July 30-Aug. 10, 1914, also 1915, 1916, (Mackie). New to Alberta list, (Dod).

3990. *Thera otisi* Dyar. Mount Brenton, B.C., (elev. 3,500 ft.)., flying over the snow, July, 1916, (Hanham).

4018. **Hydriomena californiata niveifascia* Swett. Goldstream, B.C., April 19, 1908; Victoria, B.C., June 6, 1908, (Blackmore). Can. Ent., XLVIII, 249.

4042. **Xanthorhoe defensaria gigantaria* Swett. Cowichan Bay., April 26, 1906; Victoria, B.C., April 21-May 20, 1914, 1915, (Blackmore): Duncan, B.C., April 22, 1914, (Blackmore): Can. Ent., XLVIII, 353.

4042. **Xanthorhoe defensaria thanataria* Swett. Victoria, B.C., Aug. 26 to Sept. 25, 1913, 1914, Aug. 1, 1915, (Blackmore): Can. Ent., XLVIII, 352. This is placed in the synonymy by Messrs. Barnes and McDunnough.

4042. **Xanthorhoe defensaria suppuraria* Swett. Victoria, B.C., June 2, 1914, April 25, May 2, 1915, (Blackmore): Can. Ent., XLVIII, 354. Placed in the synonymy by Messrs. Barnes and McDunnough.

4042. **Xanthorhoe defensaria conciliaria* Swett. Victoria, B.C., Sept. 18, 1913, May 14 to Aug. 26, 1914 and 1915, (Blackmore). Can. Ent., XLVIII, 352.

4072. *Euphyia intermediata* Gn. Edmonton, Alta., May 18-June 1, 1914, also 1915, 1916, (Mackie). Mr. Dod informed Mr. Mackie that in his collection *M. lacustrata* had been labelled *intermediata*, but that he now had the real *intermediata* according to Barnes and McDunnough.

4115-1. **Nomenia obsoleta* Swett. Goldstream, B.C., April 19, 1908, (R. V. Harvey); Victoria, B.C., April 19, 26, 1908, (R. V. Harvey); Can. Ent., XLVIII, 249.

4148. *Eupithecia obumbrata* Tayl. Mt. Tzuhalem, B.C., May, (Day).

4362. *Phasiane muscariata* Gn. Genoa Bay, April 24, (Hanham).

4372. *Phasiane neptaria* Gn. Mount Sicker, B.C., (elev. 2,500 ft.), July 1, (Hanham).

4405-1. **Diastictis andersoni* Swett. Atlin, B.C., July 13, 1914, (Anderson): Can. Ent., XLVIII, 251.

4470. *Caripeta aequaliaria* Grt. Cowichan Bay, B.C., Aug., (Day).

4670. *Plagodis approximaria* Dyar. Edmonton, Alta., May 22, 1915. New to Alberta list, (Dod).

4689. *Gonodontis duaria* Gn. Edmonton, Alta., May 12-31, 1913; also 1914, 1915, 1916, (Mackie). New to Alberta list, (Dod).

Pyralidæ.

5225. *Geshna primordialis* Dyar. Hull, Que., June 23, 1916, (W. T. M. Forbes).

5416. *Dicymolomia metalliferalis* Pack. Victoria, B.C., early July, 1916, (Hanham).

Aegeriidæ.

6755. *Paranthrene asilipennis* Bdv. Hamilton, Ont., May 30, 1916. Record sent by Prof. C. J. S. Bethune.

Eucosmidæ.

6778. *Evetria albicapitana* Busck. St. Williams, Ont., on jack pine branches, (Caesar).

Tortricidæ.

7399. *Eulia juglandana* Fern. Grimsby, Ont., (Caesar).
7407-1. **Tortrix oleraceana* Gibson. Larvæ on cabbage, St. John's, Nfd., (A. J. Bayly); moths emerged, Ottawa, Aug. 9-17, (Gibson); Can. Ent., XLVIII, 374.

Plutellidæ.

7656. *Harpipteryx canariella* Wlshm. Aweme, Man., July 25, 1914, (N. Criddle).

Yponomeutidæ.

7721. *Xyrosaria celastrusella* Kearf. Aweme, Man., Sept. 13, 1912, reared from seed of *Parnassia palustrus,* (N. Criddle).

Lyonetiidæ.

8106. *Lyonetia candida* Braun. The author of this species informed me that she observed the mines of *candida* at Field and Glacier, B.C., in 1915, on the white Rhododendron, *R. albiflorum.* The species was described from material reared in California and Washington States, (Gibson).
8153. **Bucculatrix crescentella* Braun. "Toronto, Canada"; Can. Ent., XLVIII, 140.

Micropterygidæ.

8481. *Epimartyria auricrinella* Wlshm. Sherbrooke, Que., Megantic, Que., (W. T. M. Forbes); Mer Bleue, near Ottawa, (Young). New to Quebec list.

COLEOPTERA.

(Arranged according to Henshaw's list of Coleoptera of America, North of Mexico.)

(Henshaw's number.)

Cicindelidæ.

30. *Cicindela hyperborea* Lec. In the collections of the Dominion Entomological Branch, there is a specimen of this rare species labelled "Sask., Canada."
35. *Cicindela hirticollis* Say. East shore of Lake Winnipeg, Man., on white sand. Years ago Mr. N. Criddle took one specimen near Aweme. It has not been taken since in Manitoba until June 17, 1916, (Wallis).
* *Cicindela hudsonica* Csy. "Hudson Bay Territory"; Memoirs on the Coleoptera VII, p. 29; issued Nov. 29, 1916.

Carabidæ.

87. *Cychrus viduus* Dej. Toronto, Ont., (C. A. Good).
122. *Carabus limbatus* Say.
123. *Carabus vinctus* Web.

Both of these species were recorded in the *Entomological Record* for 1911, from Edmonton, Alta. On further investigation it is believed that both determinations were wrong. These records, therefore, should be removed from the 1911 *Record.* (A.G.)

129. *Calosoma frigidum* Kirby. Edmonton, Alta., June 5, 1915, (Carr).
145. *Calosoma moniliatum* Lec. Millarville, Alta., May, (Tams).
150. *Elaphrus clairvillei* Kirby. Edmonton, Alta., May 22, 1915, (Carr).
163. *Blethisa julii* Lec. Millarville, Alta., June, (Tams).
(9247) *Notiophilus aquaticus* Linn. Edmonton, Alta., May 6, 1916, (Carr).
205. *Pelophila rudis* Lec. Edmonton, Alta., Oct. 11, 1915, June 20, 1916, (Carr).
300. *Nomius pygæus* Dej. Dr. C. J. S. Bethune has forwarded records of this ill-smelling beetle from Bancroft, Ont., Aug. 20, and Royal Muskoka, Ont., Aug. 24, 1916. At Ottawa we also received the species from Gravenhurst, Aug. 1, 1916, (J. A. Cockburn).
321. *Bembidium concolor* Kirby. Aweme, Man., June 13, 1909, (S. Criddle).
352. *Bembidium ustulatum* Linn. Millarville, Alta., March, 1914, (N. Criddle).
364. *Bembidium dyschirinum* Lec. Mt. Lehman, B.C., May, 1910, (Hadwen).
389. *Bembidium nigripes* Kirby. Edmonton, Alta., April 12, 1915, (Carr).
Bembidium consanguineum Hayward. Edmonton, Alta., June 29, 1916, (Carr).
403. *Bembidium scudderi* Lec. Regina, Sask., May 1, 1912, (N. Criddle); Aweme, Man., June 18, 1909, (N. Criddle). New to Manitoba.
423. *Bembidium iridescens* Lec. Mt. Lehman, B.C., April, 1910, (Hadwen).
449. *Tachys nanus* Gyll. Edmonton, Alta., May 3, 1915, (Carr).
519. *Pterostichus adoxus* Say. Kentville, N.S. (Record sent by W. H. Brittain).
562. *Pterostichus cyaneus* Lec. Aweme, Man., June 6, 1910, (E. Criddle). New to Manitoba.
567. *Pterostichus convexicollis* Say. Aweme, Man., May 14, 1914, (T. and N. Criddle).
678. *Amara remotestriata* Dej. Calgary, Alta., April 27, 1912, (N. Criddle).
Amara coelebs Hayward. Aweme, Man., March 28, 1908, April 18, 1909, (N. Criddle); Winnipeg, Man., April, May, (Wallis).
770. *Platynus reflexus* Lec. Smith's Cove, N.S. (Record sent by W. H. Brittain).
776. *Platynus piceolus* Lec. Winnipeg, Man., May 3, 1911, (Wallis).
796. *Platynus corvus* Lec. Aweme, Man., April 5, June 18, 1910, (E. & N. Criddle). New to Manitoba.
830. *Platynus picicornis* Lec. Selkirk, Man., May 24, 1911; Husavick, Man., June 22, 1912, (Wallis).
836. *Platynus nigriceps* Lec. Edmonton, Alta., Oct. 11, 1915, (Carr).
853. *Galerita bicolor* Drury. Guelph, Ont., (C. A. Good).
881. *Lebia marginalis* Dej. Aweme, Man., May 6, Oct. 4, (E. and N. Criddle). New to Manitoba.
893. *Lebia fuscata* Dej. Husavick, Man., July 7, 1915, (Roberts).
978. *Brachynus cordicollis* Dej. Aweme, Man., Aug. 20, 1910, (E. Criddle). New to Manitoba.
1030. *Chlænius alternatus* Horn. Husavick, Man., Aug. 1, 1914, (Wallis).
1031. *Chlænius purpuricollis* Rand. Aweme, Man., April 20, 1905, (N. Criddle).
1125. *Selenophorus pedicularius* Dej. Aweme, Man., May 31, 1910, (N. Criddle). New to Manitoba.
1156. *Bradycellus neglectus* Lec. Winnipeg, Man., May 5, 1909, (Wallis).
1433. *Agabus anthracinus* Mann. Edmonton, Alta., June 7, 1915, (Carr).

1446. *Agabus erichsoni* G. & H. Edmonton, Alta., Sept. 5, 1915, (Carr).
1450. *Agabus clavatus* Lec. Edmonton, Alta., April 8, 9, 10, 1916, (Carr).

Hydrophilidæ.

1550. *Helophorus lineatus* Say. Edmonton, Alta., April 29, 1914, (Carr).
1653. *Hydrobius fuscipes* Linn. Edmonton, Alta., April 29, 1916, (Carr).

Silphidæ.

1695. *Necrophorus americanus* Oliv. Truro, N.S., (record sent by W. H. Brittain); Granville Ferry, N.S., (Payne).
1696. *Necrophorus sayi* Lap. Leduc, Alta., April 25, 1914, (Carr).
1813. *Clambus puberulus* Lec. Miami, Man., June 29, 1914, (Wallis).

Staphylinidæ.

* *Baryodma ontarionis* Casey. Ottawa, Ont., (Gibson); Coaticook, Que., (Beaulne); Can. Ent., XLVIII, 71.
2125. *Staphylinus pleuralis* Lec. Edmonton, Alta., April 10, 1915, (Carr).
2136. *Staphylinus fossator* Grav. Smith's Cove, N.S., (record sent by W. H. Brittain).
Pæderus nevadensis. Edmonton, Alta., Oct. 11, 1915, (Carr).
2911. *Micropeplus tesserula* Curt. Winnipeg, Man., May 3, 1912, (Wallis).

Phalacridæ.

3000. *Olibrus semistriatus* Lec. Treesbank, Man., July 21, 1910, (Wallis).
* *Olibrus tristus* Csy. "British Columbia"; Memoirs on the Coleoptera, VII, p. 52; issued Nov. 29, 1916.

Coccinellidæ.

3052. *Hippodamia falcigera* Cr. Edmonton, Alta., June 26, Oct. 14, 1916, (Carr).
3060. *Coccinella monticola* Muls. Treesbank, Man., July 14, 1915, (Wallis).
3062. *Coccinella tricuspis* Kirby. Edmonton, Alta., May 26, 1916, (Carr); Truro, N.S., (Record sent by W. H. Brittain).
3066. *Adalia frigida* var. *disjuncta* Rand. Edmonton, Alta., May 3, 1915, (Carr).
Cleis hudsonica Casey. Edmonton, Alta., May 18, 1916, (Carr).
3072. *Anisocalvia (Harmonia) 12-maculata* Gebl. Edmonton, Alta., June 10, 1911, (Carr).
3073. *Mysia pullata* Say. Edmonton, Alta., May 10, 1915, (Carr).
3101. *Hyperaspis fimbriolata* Melsh. Three Rivers, Que., May, 1916, (Germain).
3115. *Hyperaspis pratensis* Lec. Winnipeg, Man., June 27, 1915, (Wallis).
3138. *Scymnus americanus* Muls. Husavick, Man., Aug. 2, 1914, (Wallis).
3152. *Scymnus puncticollis* Lec. Husavick, Man., July 5, 1915, (Roberts).

Colydiidæ.

3248. *Synchita fuliginosa* Melsh. Miami, Man., July 2, 1914, (Wallis).

Cucujidæ.

3314. *Pediacus fuscus* Er. Miami, Man., June 29, 1914, (Wallis).
3320. *Lamophlaus biguttatus* Say. Aweme, Man., June 25, 1915, in elm and ash bark, (N. Criddle).
3327. *Lamophlaus adustus* Lec. Winnipeg, Man., June 1, 1912, (Wallis).
3341. *Lamophlaus truncatus* Casey. Montreal, Que., found in flour, Feb., 1916, (Gibson).
3348. *Dendrophagus glaber* Lec. Edmonton, Alta., May 12, 1916, (Carr).

Cryptophagidæ.

3355. *Telmatophilus americanus* Lec. Miami, Man., June 26, 1914, (Wallis).
3363. *Henoticus serratus* Gyll. Winnipeg, Man., May 17, 1911, (Wallis).
Atomaria linearis Steph. Winnipeg, Man., May 17, 1911, (Wallis).
3388. *Atomaria ochracea* Zimm. Winnipeg, Man., May 15, 1909, (Wallis).

Dermestidæ.

3418. *Dermestes marmoratus* Say. Aweme, Man., May 13, 1916, (N. Criddle). New to Manitoba.
* *Attagenus canadensis* Csy. "Canada, (Ottawa and Quebec)"; Memoirs on the Coleoptera, VII, p. 183; issued Nov. 29, 1916.

Histeridæ.

3495. *Hister furtivus* Lec. Edmonton, Alta., May 8, 1915, (Carr); Midnapore, Alta., (Tams).
3523. *Hister æquus* Lec. Husavick, Man., July 13, 1915, (Roberts).
3564. *Paromalus bistriatus* Er. Edmonton, Alta., July 12, 1916, (Carr).

Nitidulidæ.

3681. *Carpophilus brachypterus* Say. Winnipeg, Man., May 19, 1915, (Roberts).
3709. *Epuraa truncatella* Mann. Winnipeg, Man., April 14, 1915, (Wallis); Edmonton, Alta., Sept. 30, 1915, (Carr).
3711. *Epuraa ovata* Horn. Winnipeg, Man., June 6, 1912, (Wallis).
3759. *Ips vittatus* Say. Edmonton, Alta., Sept. 22, 1915, (Carr).
3767. *Rhizophagus dimidiatus* Mann. Edmonton, Alta., Aug. 27, 1914, (Carr).

Latridiidæ.

3781. *Latridius minutus* L. Winnipeg, Man., April 21, 1914, (Wallis).
Melanopthalma gibbosa Herbst. Winnipeg, Man., May 13, 1911, (Wallis).
Melanopthalma distinguenda Com. Peachland, B.C., July 16, 1912, (Wallis).
Corticaria pubescens Gyll. Winnipeg, Man., March 30, 1916, (Wallis).
3799. *Corticaria dentigera* Lec. Winnipeg, Man., May 13, 1911, (Wallis).
3804. *Corticaria ferruginea* Gyll. Miami, Man., June 30, 1914; recorded from Hudson Bay by Hamilton, (Wallis).
3805. *Corticaria serrata* Payk. Winnipeg, Man., March 17, 1915, (Wallis).
Corticaria varicolor Fall. Winnipeg, Man., April 17, 1911, (Wallis).
3810. *Melanophthalma americana* Mann. Winnipeg, Man., April 17, 1911, (Wallis).
3826. *Melanopthalma picta* Lec. Winnipeg, Man., May 13, 1911, (Wallis).

Trogositidæ.

3833. *Trogosita chloroida* Mann. Vernon, B.C., (Brittain).
3851. *Grynocharis 4-lineata* Melsh. Winnipeg, Man., May 14, 1915, (Roberts).
* *Ostoma nigrina* Csy. "British Columbia (Aldermere) Keen"; Memoirs on the Coleoptera, VII, p. 285; issued Nov. 29, 1916.
3856. *Monotoma picipes* Hbst. Winnipeg, Man., June 24, 1911, (Wallis).

Byrrhidæ.

3881. *Simplocaria metallica* Sturm. Truro, N.S., (record sent by W. H. Brittain).

Elateridæ.

(10,049a) *Hypnoidus (Cryptohypnus) lucidulus* Mann. Edmonton, Alta., May 6, 1916, (Carr).
4210. *Elater cordatus* Horn. Edmonton, Alta., April 1, 1915, (Carr).
4220. *Elater pullus* Germ. Smith's Cove, N.S., (record sent by W. H. Brittain).
4228. *Elater socer* Lec. Edmonton, Alta., June 14, 1916, (Carr).
4245. *Elater phoenicopterus* Germ. Mt. Lehman, B.C., April, 1911, (Hadwen).
4287. *Agriötes limosus* Lec. Edmonton, Alta., June 9, 1915, (Carr).
4297. *Dolopius lateralis* Esch. Millarville, Alta., June, (Tams).
4351. *Limonius crotchii* Horn. Millarville, Alta., May 23, 1914, (Tams).
4380. *Campylus denticornis* Kirby. Husavick, Man., July 5, 1915; Aug. 19, 1915, (Roberts and E. Coates).
4496. *Corymbites inflatus* Say. Millarville, Alta., May 23, (Tams).

Buprestidæ.

4582. *Dicerca asperata* L. & G. Three Rivers, Que., July, 1916, (Germain).
4583a. *Dicerca chrysea* Melsh. Edmonton, Alta., June 3, 1915, (Carr).
Poecilonota erecta. Edmonton, Alta., July 27, 1916, (Carr).
4606b. *Buprestis rusticorum* Kirby. Granville Ferry, N.S., (Payne).
4621. *Melanophila drummondi* Kirby. Edmonton, Alta., June 25, 1916, (Carr).
4625. *Melanophila aeneola* Melsh. Peachland, B.C., July 18, 1915, (Wallis).
4630. *Anthaxia viridifrons* Lap. Peachland, B.C., July 14, 1915, (Wallis).
Chrysobothris breviloba Fall. Banff, Alta., July 2, 1915; Peachland, B.C., July 22, 1915, (Wallis).
4651. *Chrysobothris scabripennis* L. & G. Edmonton, Alta., June 18, 1916, (Carr).
4661. *Chrysobothris harrisii* Hentz. Husavick, Man., July 7, 1915, (Roberts).
4739. *Agrilus anxius* Gory. Edmonton, Alta., June 18, 1916, (Carr).

Lampyridæ.

4783. *Eros thoracicus* Rand. Husavick, Man., July 13, 1915, (Roberts).
4826. *Pyractomena lucifera* Melsh. Edmonton, Alta., June 14, 1915, (Carr).
4901. *Podabrus piniphilus* Esch. Banff, Alta., July 3, 1915, (Wallis).
4931. *Telephorus fraxini* Say. Edmonton, Alta., May 29, 1915, (Carr).
4940. *Telephorus scitulus* Say. Husavick, Man., July 4, 1915, (Roberts).
4953. *Telephorus tuberculatus* Lec. Kentville, N.S., (C. A. Good).

Cleridæ.

5136. *Cymatodera bicolor* Say. Husavick, Man., July 5, 1915, (Roberts).
5161. *Clerus apivorus* Germ. Larkin, B.C., (Brittain).

5185a. *Thanasimus nubilis* Kl. Edmonton, Alta., May 8, 1916, (Carr).
5191. *Hydnocera subfasciata* Lec. Peachland, B.C., July 23, 1915, (Wallis).

Ptinidæ.

5236. *Mezium americanum* Lap. Montreal Que., in hotel, Feb. 9, 1916, (Gibson).
5247. *Ernobius mollis* Linn. Kentville, N.S., (record sent by W. H. Brittain).
5292. *Xyletinus peltatus* Harr. Winnipeg, Man., July 1, 1911, (Wallis).
5296. *Xyletinus lugubris* Lec. Winnipeg, Man., June 27, 1915, (Wallis).
5376. *Lyctus planicollis* Lec. Winnipeg, Man., June 13, 1915, (Roberts).

Cioidæ.

Octotemnus laevus Casey. Winnipeg, Man., May 17, 1911, (Wallis); Onah, Man., May 24, 1912, (Wallis).

Scarabæidæ.

5524. *Aphodius congregatus* Mann. Edmonton, Alta., Sept. 27, 1915, (Carr).
Dichelonycha diluta Fall. Kentville, N.S., (Payne).
Dichelonycha vicina Fall. Vernon, B.C., (Brittain).
5705. *Diplotaxis obscura* Lec. Edmonton, Alta., May 20, 1916, (Carr).

Cerambycidæ.

5982. *Tetropium cinnamopterum* Kirby. Edmonton, Alta., June 29, 1916, (Carr).
6012. *Callidium hirtellum* Lec. Banff, Alta., July 4, 1915, (Wallis).
6189. *Clytus planifrons* Lec. Larkin, B.C., (Brittain).
6251. *Pachyta spurca* Lec. Swanlake, B.C., (Brittain).
6259. *Acmæops bivittata* Say. Aweme, Man., June 19, 1912, (T. Criddle).
6273. *Acmæops proteus* Kirby. Edmonton, Alta., July 19, 1916, (Carr).
6315. *Leptura exigua* Newn. Winnipeg, Man., June 19, 1915, (Wallis).
6324. *Leptura sexmaculata* Linn. Truro, N.S., (record sent by W. H. Brittain).
6361. *Leptura mutabilis* var. *luridipennis* Hald. Aweme, Man., June 9, 1906, (Wallis).
6479. *Saperda mutica* Say. Aweme, Man., June 22; July 27, 1911, (N. Criddle).
6480. *Saperda candida* Fab. Edmonton, Alta., July 17, 1916, (Carr).

Chrysomelidæ.

6541. *Donacia emarginata* Kirby. Kentville, N.S., (C. A. Good).
6551. *Zeugophora varians* Cr. Winnipeg, Man., June 13, 1915, (Roberts).
6560. *Syneta simplex* Lec. Edmonton, Alta., May 15, 1916, (Carr).
6605a. *Exema dispar* Lec. Winnipeg, Man., June 26, 1915, (Wallis).
6703. *Monachus saponatus* Fab. Husavick, Man., July 13, 1915, (Roberts).
6820. *Chrysomela basilaris* Say. Vernon, B.C., (Brittain).
6832. *Gastroidea cyanea* Melsh. Edmonton, Alta., June 24, 1915, (Carr).
6864. *Luperus varipes* Lec. Larkin, B.C., (Brittain).
6894. *Trirhabda attenuata* Say. Edmonton, Alta., July 28, 1916, (Carr).
(10,442) *Longitarsis erro* Horn. Winnipeg, Man., April 17, 1911, (Wallis).
7046. *Chætocnema subviridis* Lec. Husavick, Man., July 6, 1915, (Roberts).

Bruchidæ.

7124. *Bruchus discoideus* Say. Edmonton, Alta., July 15, 1916, (Carr).

Tenebrionidæ.

7404. *Haplandrus concolor* Lec. Winnipeg, Man., June 13, 1915, (Wallis).
7441. *Blapstinus interruptus* Say. Winnipeg, Man., June 6, 1911, (Wallis).
7520. *Platydema americanum* Lap. Winnipeg, Man., June 19, 1915, (Roberts).
Helops regulus Blaisd. Larkin, B.C., (Brittain).

Cistelidæ.

7594. *Hymenorus niger* Melsh. Husavick, Man., July 6, 1915, (Roberts).

Melandryidæ.

7665. *Enchodes sericea* Hald. Miami, Man., July 7, 1914, (Wallis).
7687. *Orchesia castanea* Melsh. Husavick, Man., July 8, 1915, (Roberts).
7695. *Canifa pallipes* Melsh. Husavick, Man., July 8, 1915, (Roberts).

Pythidæ.

7709. *Pytho niger* Kirby. Three Rivers, Que., June, 1916, (Germain).
7717. *Salpingus virescens* Lec. Edmonton, Alta., Sept. 1, 1915, (Carr).

Anthicidæ.

7876. *Stereopalpus vestitus* Say. Onah, Man., July 17, 1914, (Wallis).
7955. *Anthicus scabriceps* Lec. Husavick, Man., June 23, 1912, (Wallis).

Pyrochroidæ.

7993. *Schizotus cervicalis* Newm. Edmonton, Alta., May 23, 1915, (Carr).

Meloidæ.

8011. *Meloe strigulosus* Mann. Vernon, B.C., (Brittain).

Rhinomaceridæ.

8196. *Rhinomacer pilosus* Lec. Three Rivers, Que., May, 1916, (Germain).

Rhynchitidæ.

8221. *Rhynchites cyanellus* Lec. Truro, N.S., (record sent by W. H. Brittain; Edmonton, Alta., (Carr).

Attelabidæ.

8228. *Attelabus rhois* Boh. Three Rivers, Que., May, 1916, (Germain).

Otiorhynchidæ.

8258. *Anametis granulatus* Say. Truro, N.S., (record sent by W. H. Brittain).
8278. *Nocheles torpidus* Lec. Vernon, B.C., (Brittain).

Curculionidæ.

Apion finitimum Fall. Husavick, Man., April 22, 1912, (Wallis).
8433. *Phytonomus castor* Lec. Leduc, Alta., May 23, 1914, (Carr).

8437. *Lepyrus colon* Linn. Edmonton, Alta., (Carr).
Pissodes schwarzi Hopk. Edmonton, Alta., (Carr).
8475. *Pissodes affinis* Rand. Kentville, N.S., (C. A. Good).
8476. *Pissodes dubius* Rand. Three Rivers, Que., May, 1916, (Germain): Montreal, Que., (Beaulieu).
8619. *Magdalis subtincta* Lec. Winnipeg, Man., June 27, 1915, (Wallis).
8673. *Orchestes pallicornis* Say. Kentville, N.S., (C. A. Good).
8679. *Orchestes salicis* Linn. Truro, N.S., (record sent by W. H. Brittain).
8835. *Acanthocelis acephalus* Say. Onah, Man., July 15, 1914, (Wallis).

Platypodidæ.

* *Platypus wilsoni* Swaine. British Columbia, abundant on the coast as far north as Seymour Narrows and inland, in the south, to Agassiz; type collected at Campbell River, B.C., (Wilson and Swaine); Can. Ent., XLVIII, 97.

Ipidæ.

* *Orthotomicus lasiocarpi* Swaine. Roger's Pass, B.C.; Can. Ent., XLVIII, 183.
* *Pityokteines jasperi* Swaine. Jaspar Park, Alta.; Can. Ent., XLVIII, 182.
* *Ips chagnoni* Swaine. Montreal Island, Que., (G. Chagnon): abundant in Ontario and Quebec Provinces, (Swaine); Can. Ent., XLVIII, 186.
* *Ips vancouveri* Swaine. Quathiaski Cove, B.C.; on Vancouver Island and the coast of British Columbia; it occurs also at Kaslo, B.C., and probably elsewhere in the interior, (Swaine); Can. Ent., XLVIII, 188.
Conophthorus conicola Hopk. Pender Harbour, B.C., host cones of *Pinus monticola,* April 10, 1914, (Chrystal).
Dryocoetes confusus Swaine. Lesser Slave Lake, host *Abies balsamea,* August, (Swaine).
Dendroctonus murrayana Hopk. Banff, Alta., host *Pinus divaricata,* (Swaine).
Dendroctonus rufipennis Kirby. Algonquin Park, Ont., host *Pinus strobus,* Oct., (Swaine).
9183. *Dendroctonus simplex* Lec. Lesser Slave Lake, Alta., host *Larix americanus,* Aug., (Swaine).
9188. *Scierus annectens* Lec. Lesser Slave Lake, Alta., host White Spruce, Aug., (Swaine).
9195. *Hylastes porosus* Lec. Arrowhead, B.C., host *Pinus monticola,* (Swaine).
9198. (*Hylurgops*) *granulatus* Lec. Nanaimo, B.C., May, host *Abies grandis,* (Wilson).

DIPTERA.

(Arranged according to a Catalogue of North American Diptera, by J. M. Aldrich, Smithsonian Misc. Coll. XLVI, No. 1, 444. The numbers refer to the pages in the catalogue.)

Tipulidæ.

80. *Limnobia parietina* O. S. Ottawa, Ont., Aug. 1, 1906, (J. Fletcher).
* *Gonomyia californica* Alex. Peachland, B.C., May 19, 1912; Can. Ent., XLVIII, 324.
* *Trichocera* (*Diazosma*) *subsinuata* Johns. Waubamic, Parry Sound, Ont., June 13, 1915, (H. S. Parish); Jour. N.Y. Ent. Soc., XXIV, 124.
* *Limnophila terræ-novæ* Alex. Sandy Cove, Nfd., July 28, 1906, (O. Bryant); Jour. N.Y. Ent. Co., XXIV, 123.

95. *Bittacomorpha clavipes* Fab. Go Home Bay, Ont., May 23, 1912, (Walker).
95. *Bittacomorpha sackenii* Roeder. Massett, Q. C. I., 1898, (J. H. Keen).
96. *Xiphura frontalis* O. S. Ottawa, Ont., June 6, 1900, (Gibson).
97. *Pachyrhina erythrophrys* Will. Prince Albert, Sask., June 23, 1913, (Walker).
99. *Holorusia grandis* Bergr. Departure Bay, Vanc. Is., B.C., July 18, 1913, (Walker).
101. *Tipula bella* Lw. Go Home Bay, Ont., May 23, 1912, (Walker).
104. *Tipula trivittata* Say. Go Home Bay, Ont., June 20, Aug. 12, 1912, (Walker).
* *Tipula penicillata* Alex. "Hudson Bay Territory, (Kennicott)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 496.
* *Tipula loewiana* Alex. "Fort Resolution, Hudson Bay Territory, (Kennicott)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 489.
* *Tipula imperfecta* Alex. "Labrador, (Packard)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 484.
* *Tipula piliceps* Alex. "Hudson Bay Territory, (Kennicott)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 482.
* *Tipula kennicotti* Alex. "Fort Resolution, Hudson Bay Territory, (Kennicott)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 481.
* *Tipula mainensis* Alex. Grand Lake, Nfd. July 25, 1906, (Bryant); Proc. Acad. Nat. Sci., Philadelphia, LXVII, 475.
* *Tipula pachyrhinoides* Alex. Farewell Creek, Southern Saskatchewan, Sept. 1907; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 471.
* *Tipula algonquin* Alex. Go Home Bay, Muskoka, Ont., Aug. 16, 1912, (Clemens); Proc. Acad. Nat. Sci., Philadelphia, LXVII, 471.
* *Tipula parshleyi* Alex. Barber Dam, N.B., June 25, 1914, (McKenzie); Fredericton, N.B., June 10, 1914, (Tothill); "British America, (Scudder)"; Proc. Acad. Nat. Sci., Philadelphia, LXVII, 510.

Cecidomyidæ.

Diarthronomyia hypogæa H. Lw. This European insect has recently been found infecting chrysanthemums at Ottawa, Ont., (Gibson), and Victoria, B.C., (A. E. Cameron).
* *Dasyneura sassafras* Felt. Jordan, Ont., (not Gordon as stated in description), Aug. 12, 1915, (Ross); Can. Ent., XLVIII, 29.
156. *Dasyneura rhodophaga* Coq. Infesting buds of roses in greenhouse in Toronto, Ont., larvæ received at Ottawa, Oct., 1916. First occurrence as a greenhouse pest in Canada, (Gibson).

Bibionidæ.

165. *Bibio abbreviatus* Loew. Lethbridge, Alta., April 16, 1915, (Strickland).
166. *Bibio fraternus* Loew. Lethbridge, Alta., April 16, 1915, (Strickland).

Scatopsidæ.

Androrandiella halterata Mg. In Bull. No. 160, (April, 1916), Agric. Exp. Stn., Washington, Melander records this species in America, based on specimens collected at Waubamic, Parry Sound, Ont., June 14, 1915, and Sudbury, Ont., July 22, 1915).

Simuliidæ.

Simulium piscicidium Riley. Smoky R. Crossing, Alta., Aug. 24, 1915, (Strickland).

170. *Simulium vittatum* Zett. Bear Lake, Alta., Aug. 18, 1915, (Strickland).

Stratiomyidæ.

182. *Stratiomyia barbata* Loew. Mt. Cheam, B.C., July 23, 1915, (Treherne).
182. *Stratiomyia discalis* Loew. Kelowna, B.C., June 2, 1914, (Rhumann).
183. *Stratiomyia meigenii* Wied. Ottawa, Ont., June 16, 1913, (Beaulne).
184. *Odontomyia arcuata* Loew. Rosthern, Sask., July 17, 1916, (Sladen).
186. *Odontomyia interrupta* Oliv. Ottawa, Ont., May 29, 1899, (Gibson); July 16, 1913, (Beaulne).
190. *Nemotelus glaber* Loew. Ottawa, Ont., July 2, 1912, (Beaulieu).

Nemotelus polita Loew. Montreal, Que., June 8, 1906, (Beaulieu).

Tabanidæ.

194. *Pangonia tranquilla* O. S. Montfort, Que., July 12, 1916, (G. Chagnon). Only one record, viz., Levis, in Winn and Beaulieu's Quebec list of Diptera; Algonquin Park, Ont., Aug. 1, 1916, (Walker and Lozier).
195. *Chrysops celer* O. S. Algonquin Park, Ont., Aug. 17, 1904, (Hahn); Go-Home Bay, Ont., June 24, 1907, (W. J. Fraser); Toronto, Ont., June 16, 1915, (Walker).
195. *Chrysops moerens* Walk. De Grassi Point, Ont., July 21, 1916, (Walker).
196. *Chrysops delicatulus* O. S. Go-Home Bay, Ont., July 6, 31, 1907, (W. J. Fraser).
196. *Chrysops indus* O. S. Toronto, Ont., June 12, 1895, (Walker).
197. *Chrysops montanus* O. S. Go-Home Bay, Ont., July 1, 1907, (W. J. Fraser).
197. *Chrysops obsoletus* Wied. Ontario, (locality uncertain). Record from E. M. Walker.

Chrysops shermani Hine. Algonquin Park, Ont., July 31, 1916, (Walker).

199. *Hæmatopota americana* O. S. Ducks, B.C., July 20, 1915, (Hadwen).
200. *Tabanus actæon* O. S. Muskoka, Ont., July 29, 1888, (E. M. Morris).
201. *Tabanus astutus* O. S. Algonquin Park, Ont., July 28, 30, 1916, (Walker and Lozier); Go-Home Bay, Ont., June 28, 1907, (W. J. Fraser); Muskoka, Ont., July 21, 1888, (E. M. Morris).
202. *Tabanus coffeatus* Macq. Muskoka, Ont., July 21, 1888, (E. M. Morris).
202. *Tabanus comastes* Will. Mt. Cheam, B.C., July 1915, (Treherne).
204. *Tabanus hirtulus* Bigot. Agassiz, B.C., May 23, 1915, (Hadwen).
204. *Tabanus lasiophthalmus* Macq. De Grassi Point, Ont., June 26, 1915, (Walker).

Leptidæ.

211. *Arthropeas americana* Loew. Aweme, Man., June 25, 1913, (N. Criddle); Kinistino, Sask., July 10, (J. Fletcher).
212. *Xylophagus rufipes* Loew. Ottawa, Ont., June 6, 1909, (J. A. Letourneau).
213. *Glutops singularis* Burgess. Agassiz, B.C., June, 1915, (Treherne).

Bombyliidæ.

221. *Spogostylum pluto* Wied. Kaslo, B.C., July 20, (Cockle).

Asilidæ.

259. *Dioctria albius* Walk. Montfort, Que., July 12, 1916, (G. Chagnon). New to Quebec List.
259. *Dioctria sackeni* Will. Montfort, Que., July 12, 1916, (G. Chagnon). New to Quebec list.
260. *Cyrtopogon montanus* Loew. Victoria, B.C., June 1, 1885, (J. Fletcher).
260. *Cyrtopogon nebulo* O. S. British Columbia, Oct. 2, 1904. Specimen so labelled is in collection of Entomological Branch.
272. *Laphria ferox* Will. Vancouver, B.C., July, 1914, (Chrystal).
272. *Laphria pubescens* Will. Scotia Junction, Ont., July 7, 1907, (J. Fletcher).
280. *Promachus fitchii* O. S. Aweme, Man., July 13, 1907, (J. Fletcher).
283. *Asilus sadyates* Walk. St. John's Que., July 7, 1916, (G. Chagnon). New to Quebec list.

Empidæ.

311. *Drapetis medetera* Mel. Estevan, Sask., May 20, (N. Criddle).

Phoridæ.

* *Phora* (=*Trineura*) *viridinota* Brues. Treesbank. Man., May 30. (N. Criddle); Can. Ent., XLVIII, 394.

Platypezidæ.

* *Callimyia velutina* Johns. Brule Lake, Ont., Aug. 3, 1911, (M. C. Van Duzee); Psyche, XXIII, 32.

Syrphidæ.

346. *Microdon globosus* Fab. Manitoba, Aug. 19, 1900; 2 specimens so labelled in collection of Entomological Branch.

Eumerus strigatus Fall. In the collection at Ottawa is a specimen taken by the late Dr. J. Fletcher at Ottawa on Aug. 19, 1904, which had been placed among specimens of *Xylota ejuncida*. This represents the first capture in the open, that we know of, for Canada. We have a number of specimens reared from imported narcissus bulbs, (Gibson).

362. *Leucozona lucorum* L. Smith's Cove, N.S., July 4-15, 1914, (Gibson).

* *Volucella bombylans arctica* Johns. Labrador: Rama, 1898, (A. Stecker and J. D. Sornborger: Nain, (J. D. Sornborger): Nain, Aug. 18, 1908, (O. Bryant): Psyche XXIII, 163.

* *Volucella bombylans lateralis* Johns. Lewisport, Nfd., July, (L. D. Gratacap); Red Indian Lake, Nfd., June 20, 1906, (O. Bryant); Psyche, XXIII, 161.

383. *Arctophila flagrans* O. S. Banff, Alta., July 18, 1916, (Hewitt).
398. *Xylota analis* Will. Mt. Cheam, B.C., July 21, 1905, (Treherne).
398. *Xylota barbata* Loew. Aylmer, Que., June 24, 1913, (Beaulne). New to Quebec list.
398. *Xylota bicolor* Loew. Chelsea, Que., May 26, 1900, (Gibson). New to Quebec list.
398. *Xylota ejuncida* Say. Stuart River, Yukon Territory, 1909, (D. H. Nelles).
400. *Xylota vecors* O. S. Ottawa, Ont.: St. Louis, Sask., 1898, (E. Coubeaux).

402. *Criorhina armillata* O. S. Inverness, B.C., July, 1910, Metlakatla, B.C., Aug., 1911, (J. H. Keen).

Œstridæ.

416. *Hypoderma lineata* DeV. Cadbora Bay, B.C., on flowers of *Camassia quamash*, May 10, 1916; first capture of the male of this species in British Columbia, (Treherne).

Tachinidæ.

426. *Gymnophania montana* Coq. Lethbridge, Alta., May 15, 1916, (Strickland). New to Canada, (J. M. A.).
* *Exorista caesar* Aldrich. Reared from *Archips argyrospila* from Simcoe, Ont., July 1-15, 1915, (Caesar); Can. Ent., XLVIII, 20.
* *Frontina spectabilis* Aldrich. Waubamic, Parry Sound, Ont., Aug. 5, 1915, (H. S. Parish); Can. Ent., XLVIII, 22.

Sarcophagidæ.

* *Sarcophaga aldrichi* Parker. "Canada, (Quebec)"; Jour. Econ. Ent., Vol. 9, p. 438. Mountain, Ont., larvæ found in great frequency in pupæ of Forest Tent-caterpillar, (Caesar).
* *Sarcophaga pachyprocta* Parker. "Canada, (Manitoba ?)"; Jour. N.Y. Ent. Soc., XXIV, 171.
* *Sarcophaga fletcheri* Ald. Aweme, Man., June 19, 1903, (J. Fletcher); Sarcophaga and Allies in North America, (Thomas Say Foundation), p. 96; issued Nov. 30, 1916.
* *Sarcophaga reversa* Ald. "Montreal, Que., (Harbeck)"; Sarcophaga and Allies in North America, p. 135.
* *Sarcophaga falciformis* Ald. Aweme, Man., July 25, 1913, (not 1813 as in description); Sarcophaga and Allies in North America, p. 137.
* *Sarcophaga aculeata* Ald. "London, Ont., (Hough coll.)"; Sarcophaga and Allies in North America, p. 143.
* *Sarcophaga occidentalis* Ald. Vancouver, B.C., July 27, 1907, (R. V. Harvey); Sarcophaga and Allies in North America, p. 198.
* *Sarcophaga tuberosa sarraceniodes* Ald. Okanagan Valley, B.C., ex. *Anabrus*, emerged April, 1896, (J. Fletcher); Sarcophaga and Allies in North America, p. 227.

Muscidæ.

524. *Protocalliphora azurea* Fall. Ottawa, Ont., Aug. 6, 1914, (Beaulne).

Anthomyidæ.

* *Hydrotæa houghi* Mall. London, Ont., (ex. Coll. Hough); Bull. Brooklyn Ent. Soc., XI, p. 110.

535. *Hydrotæa unispinosa* Stein. Wakefield, Que., June 18, 1915, (Hewitt).
Mydæa punctata Stein. Lethbridge, Alta., June 14, 1916, (Strickland).
* *Mydæa pectinata* Johannsen. Millville, N.S.: Trans. Amer. Ent. Soc., XLII, p. 392.
* *Phaonia apicata* Johannsen. Truro, N.S., Aug.; Trans. Amer. Ent. Soc., XLII, p. 396.

563. *Schoenomyza dorsalis* Loew. Lethbridge, Alta., June 5, 1916, (Strickland).

Sciomyzidæ.

Tetanocera flavipes Loew. Aweme, Man., July 1, 1913, (N. Criddle).
Tetanocera sparsa Loew. Ottawa, Ont., July 17, 1904, (W. Metcalfe).
580. *Sepedon armipes* Loew. Brockville, Ont., Sept. 20, 1903, (Metcalfe).

Ortalidæ.

Tetanops aldrichi Hendel. Lethbridge, Alta., May 15, 1916, (Strickland). New to Canada, (J. M. A.).
598. *Seoptera vibrans* L. Teulon, Man., June 19, 1915, (W. Chesney).

Trypedidæ.

603. *Stenopa vulnerata* Loew. Banff, Alta., (Sanson).
606. *Rhagoletis pomonella* Walsh. Aweme, Man., Aug. 8, 1916, (N. Criddle); Penticton, B.C., July 26, 1916, (Treherne).

Ephydridæ.

Psilota compta Mg. Lethbridge, Alta., May 15, 1916, (Strickland).
627. *Hydrellia formosa* Loew. Ottawa, Ont., July 12, 1916, (Beaulieu).
Philygria picta. Ottawa, Ont., July 12, 1916, (Beaulieu); Estevan, Sask., May 20, 1916, (N. Criddle).
627. *Philygria fuscicornis* Loew. Lethbridge, Alta., May-June, (Strickland).
627. *Hyadina albovenosa* Coq. Aweme, Man., Aug. 3, 1916, (N. Criddle).

Oscinidæ.

633. *Diplotoxa microcera* Loew. Strathroy, Ont., (H. G. Crawford); Ottawa, Ont., Aug. 9, 22, 1916, (Beaulieu).
633. *Chlorops graminea* Coq. Aweme, Man., June 27, 1916, (N. Criddle). New to Canada, (J. M. A.).
633. *Chloropisca grata* Loew. Aweme, Man., Aug. 22, 1916, (N. Criddle); Ottawa, Aug. 31, 1916, (Beaulieu); Sept. 12, (Miss G. Beaulieu).
Chloropisca pulla Ad. Lethbridge, Alta., May 15, 1916; Ogema, Sask., June 18, 1916, (N. Criddle); Aweme, Man., June 9, 12, (N. Criddle). New to Canada, (J. M. A.).
634. *Chlorops producta* Loew. Aweme, Man., Aug. 15, 1916, (N. Criddle).
634. *Chlorops sulphurea* Loew. Ogema, Sask., June 18, 1916, (N. Criddle).
634. *Chloropisca varipes* Loew. Aweme, Man., June 12, 1916, (N. Criddle).
634. *Diplotoxa recurva* Ad. Maryfield, Sask., Sept. 2, (N. Criddle).
635. *Hippelates plebeius* Loew. Ottawa, Ont., Sept. 9, 1916, (Miss G. Beaulieu).
Tricimba cincta Mg. Ottawa, Ont., July 29, 1916, (Beaulieu); Aweme, Man., June 27, (N. Criddle).
Elachiptera decipiens Loew. Ogema, Sask., June 17, 1916, (N. Criddle).
636. *Elachiptera costata* Loew. Estevan, Sask., May 20, 1916, (N. Criddle); Ogema, Sask., June 17, 1916, (N. Criddle); Aweme, Man., Sept. 4, 1916, (N. Criddle); Hemmingford, Que., July 27, 1916, (Petch). New to Quebec list.
636. *Elachiptera eunota* Loew. Aweme, Man., Aug. 22, 1916, (N. Criddle). New to Manitoba.

Siphonella aequa Becker. Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list.

Siphonella geniculata DeG. Estevan, Sask., May 20, 1916, (N. Criddle).

Siphonella neglecta Becker. Aweme, Man., Aug. 15, 1916, (N. Criddle).

Siphonella nigripalpis Mall. Strathroy, Ont., June 20, 1916, (H. G. Crawford); Hemmingford, Que., July 28, 1916, (Petch). New to Quebec list.

Siphonella parva Ad. Hemmingford, Que., July 28, Aug. 10, 1916, (Petch). New to Quebec list.

637. *Siphonella pumilionis* Bj. Aweme, Man., Aug. 15, 1916, (N. Criddle).

Oscinis dissidens Tucker. Ottawa, Ont., July 12, 1916, (Beaulieu).

Oscinis melancholica Becker. Ottawa, Ont., Aug. 31, Sept. 9, 1916, (Beaulieu).

639. *Oscinis umbrosa* Loew. Strathroy, Ont., Aug. 9, 1916, (H. G. Crawford); Hemmingford, Que., June 27, July 28, 1916, (Petch). New to Quebec list.

Drosophilidæ.

* *Drosophila sulcata* Sturtevant. "Ottawa, Can.; Annals Ent. Soc. Amer., IX, 330."

Geomyzidæ.

Trixocelis fumipennis Mall. Aweme, Man., June 12, 1916, (N. Criddle).

Anthomyza gracilis Fall. Aweme, Man., Aug. 3, 1916, (N. Criddle). New to Manitoba.

Agromyzidæ.

647. *Phytomyza nigritella* Zett. Estevan, Sask., May 20, 1916, (N. Criddle). New to Saskatchewan.

Phytomyza bipunctata Lw. Estevan, Sask., May 20, 1916, (N. Criddle). New to Saskatchewan.

647. *Cerodonta dorsalis* Loew. Strathroy, Ont., Aug. 23, 28, 1916, (H. G. (Crawford); Ottawa, Ont., Aug. 17, 1916, (Beaulieu); Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list.

Paramyia nitens Loew. Mer Bleue, near Ottawa, Ont., June 26, 1904, (Metcalfe).

Agromyza coniceps Mall. Aweme, Man., June 2, 1916, (N. Criddle). New to Canada.

Agromyza coquilletti Mall. Strathroy, Ont., July 4, 1916, (H. G. Crawford).

Agromyza fragariæ Mall. Estevan, Sask., May 20, 1916, (N. Criddle).

Agromyza immaculata Coq. Ogema, Sask., June 17, 1916, (N. Criddle).

648. *Agromyza jucunda* Van der Wulp. Estevan, Sask., May 20, 1916, (N. Criddle); Hemmingford, Que., July 28, 1916, (Petch). New to Quebec list.

Agromyza laterella Zett. Ottawa, Ont., May 25, 1916, (Beaulieu); Aweme, Man., Aug. 4, 15, 1916, (N. Criddle).

648. *Agromyza longipennis* Loew. Aweme, Man., Aug. 15, 1916, (N. Criddle). New to Manitoba.

Agromyza nasuta Mel. Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list. Mines in dandelion, (J. M. A.).

Agromyza scutellata Fall. Estevan, Sask., May 20, 1916, (N. Criddle).

Agromyza vibrissata Mall. Aweme, Man., June 12, 1916, (N. Criddle).

649. *Agromyza virens* Loew. Aweme, Man., Aug. 22, 1916, (N. Criddle); Ottawa, Ont., July 21, 1916, (Beaulieu).

649. *Desmometopa latipes* Mg. Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list.

Desmometopa sordida Fall. Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list.

651. *Pholeomyia indecora* Loew. Strathroy, Ont., July 4, 1916, (H. G. Crawford).

Ochthiphila aridella Fall. Hemmingford, Que., Aug. 10, 1916, (Petch). New to Quebec list. Aweme, Man., Sept. 4, 1916, (N. Criddle).

652. *Ochthiphila polystigma* Mg. Strathroy, Ont., Aug. 9, 1916, (H. G. Crawford).

Hymenoptera.

Much valuable material is being accumulated and worked over as opportunity offers. The aculeate hymenoptera are receiving close study by Mr. F. W. L. Sladen, of Ottawa, who has visited many parts of Canada during 1916 and made valuable collections. Through the courtesy of Dr. H. T. Fernald, of the Massachusetts Agricultural College, Amherst, Mass., Mr. J. F. Martin examined ichneumonid material, and the records of these given below are of interest in adding to our knowledge of their distribution in Canada.

Tenthredinidæ.

Zaschizonyx montana (Cress.). Ottawa, Ont., Aug. 1915, (Germain). New to Canada, (S. A. R.).

Macrophya crassicornis Prov. Ottawa, Ont., June, 1915, (Germain).

Pachynematus extensicornis Nort. Ottawa, Ont., July, 1915, (Germain).

Pachynematus tritici Marl. Ottawa, Ont., July, 1915, (Germain).

Pontania robusta Marl. Ottawa, Ont., June, 1915, (Germain). New to Canada, (S. A. R.).

Blennocampa aperta MacG. Ottawa, Ont., July, 1915, (Germain). New to Canada, (S. A. R.).

Ichneumonidæ.

Exochus propinquus Cr. Lethbridge, Alta., July 3, 1913, (Strickland).

Bassus orbitalis Cr. Lethbridge, Alta., Sept. 21, 1913, (Strickland).

Mesoleius tenthredinis Morley. This European parasite of the Large Larch Sawfly, *Nematus erichsonii*, introduced into Manitoba by Dr. C. Gordon Hewitt (Rep. Dom. Entomologist, for year ending March 31, 1913) has in 1916, been captured near Aweme, Man., by Mr. Norman Criddle, on the dates June 2 to 21.

Cryptus luctuosus Cr. Lethbridge, Alta., Sept. 20, 1913, (Strickland).

Ichneumon calitergus Cr. Ottawa, Ont., Aug. 26, 1899, (J. Fletcher).

Ichneumon lewisii Cr. Ottawa, Ont., Aug. 28, 1906, (Young).

Ichneumon longulus Cr. Aweme, Man., Aug. 20, 1915, (N. Criddle).

Ichneumon vicinus Cr. Ottawa, Ont., April 21, 1900, (Gibson).
Ichneumon subdolus Cr. Nipigon, Ont., July 11, 1907, (J. Fletcher).
Amblyteles montanus Cr. Ottawa, Ont., Aug. 24, 1903, (J. Fletcher).
Trogus quebecensis Prov. Hymers, Ont., July 21, 1910, (Dawson).

Trichogrammidæ.

* *Trichogramma tomyia tortricis* Girault. Guelph, Ont., from eggs of *Tortrix cerasivorana*, (Bethune); Can. Ent., XLVIII, 268.

Encyrtidæ.

* *Aphycus rileyi* Timb. Guelph, Ont., reared from *Lecanium corni* on ash, June 9, 1907, (T. D. Jarvis); Proc. U.S.N.M., Vol. 50, p. 600.
* *Berecyntus bakeri gemma* Girault. Reared at Ottawa from *Euxoa* larva from Queensboro, Ont., also from larva of *Hadena devastatrix*, Ottawa, Ont., July 12, 1914, (Gibson); Psyche XXIII, 49.

Thynnidæ.

Methoca bicolor Say. Prince Albert, Sask., male, July 22, 1916, (Sladen).

Mutillidæ.

Mutilla hexagona Say. Toronto, Ont., males, July, August, 1888-1894, (W. Brodie).
Mutilla canadensis Blake. Weymouth, N.S., female, June 5, 1913, (Sanders).

Myrmosidæ.

Myrmosa unicolor Say. Aweme, Man., male, July 7, 1915, (N. Criddle); Prince Albert, Sask., July 22, 1916, (Sladen).

Tiphiidæ.

Paratiphia albilabris Spin. Okanagan, B.C., female, Aug. 4, 1915, (Anderson); Victoria, B.C., Aug. 13, 1916, (Sladen).

Sapygidæ.

Sapyga martini Sm. Aweme, Man., May 2, 9, 1915, (N. Criddle).

Eumenidæ.

Odynerus capra Sauss. Truro, N.S., Aug. 16, 1915, (Brittain).

Philanthidæ.

Eucerceris superbus Cr. Medicine Hat, Alta., male, Aug. 20, 1916, (Sladen).
Eucerceris bicolor Cr. Medicine Hat., Alta., female, Aug. 20, 1916, (Sladen). Mr. Sladen considers the evidence strong that this species is the female of *E. superbus*.
Eucerceris flavocinctus Cr. Indian Head, Sask., July 14, 1916, (Sladen); Kaslo, B.C., July 20, 1906, (Cockle); Sidney, B.C., July 6, 1914, (Sladen).

Eucerceris fulvipes Cr. Aweme, Man., (N. Criddle); Medicine Hat, Alta., male, Aug. 20, 1916, (Sladen).

Cerceris clypeata Cr. (var. with cream-colored bands). Prince Albert, Sask., female, July 22, 1916, (Sladen).

Cerceris dentifrons. Toronto, Ont., Aug. 1, 1893, (W. Brodie).

Cerceris pleuralis H. S. Smith. Toronto, Ont., Aug. 1, 1893, (W. Brodie).

Cerceris rufinoda Cr. Medicine Hat, Alta., Aug. 20, 1916, (Sladen).

Cerceris rufinoda crucia Vier. & Ckll. Medicine Hat, Alta., Aug. 20, 1916, (Sladen).

Philanthus solivagus Say. Kentville, N.S., Aug. 22, 1915, (Brittain); Aweme, Man., July 29, 1915, (N. Criddle).

Philanthus bilunatus Cr. St. Stephen, N.B., July 18, 1916, (Sanders); Melfort, Sask., July 20, 1916, (Sladen).

Philanthus politus Say. Prince Albert, Sask., July 22, 1916; Calgary, Alta., July 29, 1916, (Sladen).

Philanthus albopilosus Cr. Aweme, Man., Aug. 20, 1914, (N. Criddle); Medicine Hat, Alta., Aug. 20, 1916, (Sladen).

Philanthus sanbornii Cr. Toronto, Ont., Aug. 4, 1895, (W. Brodie).

Philanthus punctatus Say. Thompson River, B.C., Aug. 8, 1914, (Wilson); Crescent, B.C., Aug. 14, 1916; Agassiz, B.C., Aug. 10, 1916; Medicine Hat, Alta., Aug. 20, 1916, (Sladen).

Aphilanthops frigidus Sm. Radisson, Sask., July 30, 1907, (J. Fletcher); Medicine Hat, Alta., Aug. 20, 1916; Lethbridge, Alta., June 28, 1911; Victoria, B.C., Aug. 13, 1916, (Sladen).

Bembecidæ.

Bembex pruinosa Fox. Aweme, Man., Aug. 20, 1914, (N. Criddle).

Bembex amœna Fox. Nicola Valley, B.C., June, 1912, (S. Hadwen).

Monedula emarginata Cr. Prince Albert, Sask., July 22; Lethbridge, Alta., July 25, 1916, (Sladen).

Andrenidæ.

* *Andrena ricardonis* Ckll. Vernon, B.C., June 9, 1902, (Miss Ricardo); Can. Ent., XLVIII, 272.

Andrena cockerelli Graen. Smith's Cove, N.S., May 26, 1915, (Brittain).

Andrena bicolor Prov. Smith's Cove, N.S., June 5, 1915, (Brittain).

Andrena vicina Sm. Smith's Cove, N.S., May 30, 1915, (Brittain).

Andrena carlini Ckll. Smith's Cove, N.S., May 25, 1915, (Brittain).

Nomadidæ.

* *Nomada vernonensis* Ckll. Vernon, B.C., April 15, 1902, (Miss Ricardo); Can. Ent., XLVIII, 273.

Megachilidæ.

Anthidium tenuifloræ Ckll. Banff, Alta., July 24, 1911, (Sanson); Radisson, Sask., July 29, 1907; Saskatoon, Sask., July 18, 1909, (Willing); Invermere, B.C., June 30, 1914, (Sladen).

Anthidium emarginatum Say. Aweme, Man., July 20, 1914, (N. Criddle); Banff, Alta., Aug. 17, 1911, (Sanson).

Dianthidium simile Cr. Guelph, Ont., 1913, (A. Burrows); Ottawa, July 7, 1913, (Sladen).

Microstelis lateralis Cr. Toronto, Ont., June 24, 1894, (W. Brodie); Aylmer, Que., June 5, 1915, on *Potentilla,* (Sladen).

Parostelis montana Cr. Lethbridge, Alta., June 28, 1914, (Sladen); Banff, Alta., (Sanson).

* *Stelis ontariana* Sladen. Ottawa, Ont., Aug. 16, 1912, (Beaulne); Bethesda, Ont., Aug. 15, 1892, (W. Brodie); Can. Ent., XLVIII, 312.

* *Autochelostoma canadensis* Sladen. Ottawa district, Ont., Aug. 14, 1914, (Germain); Can. Ent., XLVIII, p. 270.

Chelynia subemarginata Cr. Toronto, Ont., June 23, 1891. (W. Brodie); Aylmer, Que., June 24, 1913, (Beaulne); Dalhousie, N.B., July 24, 1915, (Sladen).

Chelynia foederalis Sm. Toronto, Ont., June 9, 1896, (W. Brodie); Ottawa, June 11, 1913, (Sladen).

Chelynia rubri Ckll. Banff, Alta., June 25, 1908, (Sanson).

Heriades carinatus Cr. Invermere, B.C., June 30, 1914, (Sladen).

Chlorosmia fulgida Cr. Banff, Alta., (Sanson); Invermere, B.C., July 1, 1914, (Sladen).

* *Formicapis clypeata* Sladen. Aweme, Man., July 6, 1915, (Criddle); Waterhole, Alta., Aug. 18, 1915, (Strickland); Melfort, Sask., July 20, 1916, (Sladen); Can. Ent., XLVIII, p. 271.

Osmia cobaltina Cr. Shawnigan, B.C., July 7, 1914, (Sladen); Peachland, B.C., July 24, 1909, (Wallis).

Osmia kenoyeri Ckll. White River, Ont., June 3, 1915, (Sladen).

Osmia nigrifrons Cr. Invermere, B.C., June 30, 1914, (Sladen).

Osmia novomexicana Ckll. Aweme, Man., April 30, 1910, (N. Criddle); Medicine Hat, Alta., May 30, 1904, (Willing).

Osmia chalybea Sm., var. *faceta* Cr. Ottawa, Ont., July 26, 1913, (Sladen); Toronto, Ont., July 26, 1890, (W. Brodie).

Osmia chalybea Sm. var. *mandibularis* Cr. Lethbridge, Alta., July 8, 1909, (Wallis).

Osmia densa Cr. Banff, Alta., May 17, 1915; Golden, B.C., May 16, 1915; Shawnigan, B.C., July 7, 1914, (Sladen).

Osmia albiventris Cr. Ottawa, Ont., June 11, 1913; White River, Ont., June 3, 1915; Banff, Alta., May 21, 1915, (Sladen).

Osmia atriventris Cr. St. John, N.B., May 23, 1903, (Leavitt); Aweme, Man., May 2, 1914, (N. Criddle); Ottawa, Ont., May 18, 1913; Banff, Alta., May 21, 1915, (Sladen).

Osmia melanotricha Lov. & Ckll. Toronto, Ont., June 10, 1894, (W. Brodie); Ottawa, Ont., June 18, 1913, (Sladen).

Osmia hudsonica Cr. Banff, Alta., May 21, 1915, (Sladen).

Megachile (Oligotropus) exilis, subexilis, Ckll. Males, Ottawa, Ont., July 15, 1913; Kaslo, B.C., Penticton, B.C., Aug., 1916, (Sladen).

Megachile fidelis Cr. Summerland, B.C., Aug. 9, 1916, (Sladen).

Megachile pugnata Say. Edmonton, Alta., July 11, 1916. (Carr); Salmon, Arm, B.C., July 4, 1914; Shawnigan, B.C., July 7, 1914, (Sladen).

Megachile manifesta Cr. Davidson, Sask., Aug. 21, 1907, (Willing); Medicine Hat, Alta., Aug. 20, 1916; Lethbridge, Alta., July 28, 1916; Swift Current, Sask., Aug. 22, 1916, (Sladen).

Megachile melanophaea Sm. Halifax, N.S., July 10, 1916, (Perrin).

Megachile melanophaea var. *calogaster* Ckll. Lethbridge, Alta., June 28, 1914, (Sladen).

Megachile latimanus Say. Smith's Cove, N.S., July 15, 1914, (Gibson); Melfort, Sask., July 20, 1916; Lethbridge, Alta., June 28, 1913, (Sladen).

Megachile perihirta Ckll. Salmon Arm, B.C., July 11, 1914, Lethbridge, Alta., June 28, 1914, (Sladen).

Megachile latimanus Ckll., (not Say.). Lethbridge, Alta., June 28, 1914, (Sladen).

Megachile vancouverensis Prov. St. John, N.B., July 13, 1901, (Leavitt); Kaslo, B.C., June 10, 1906, (Cockle); Ottawa, Ont., Aug. 15, 1913; Invermere, B.C., June 30, 1914, (Sladen).

Megachile inermis Prov. (*decipiens* Lov. & Ckll.). St. John, N.B., July 1, 1901, (A. G. Leavitt); Dalhousie, N.B., July 24, 1915; Hull, Que., June 14, 1914; Haileybury, Ont., July 7, 1916, (Sladen); Bondville, Que., July 30, (Winn); Dunvegan, Alta., Aug. 18, 1915, (Strickland); Aweme, Man., June 29, 1915, (N. Criddle).

Megachile parallela Ckll. Thompson River, B.C., Aug. 8, 1914, (Wilson); Medicine Hat, Alta., Aug. 20, 1916, (Sladen); Swift Current, Sask., Aug. 22, 1916, (Sladen).

Megachile generosa Cr. Aweme, Man., July 13, 1916, (N. Criddle); Lethbridge, Alta., July 28, 1916, (Sladen).

Megachile brevis Say. Haileybury, Ont., July 5, 1916, (Sladen); Summerland, B.C., Aug. 10, 1916, (Sladen).

Coelioxys ribis Ckll. Truro, N.S., July 4, 1913, (C. B. Gooderham); Haileybury, Ont., July 5, 1916, (Sladen); Aweme, Man., July 13, 1916, (N. Criddle).

Bombidæ.

Bombus rufocinctus Cr. Charlottetown, P.E.I., Sept., 1916, (Sladen).

Bombus californicus Smith. Prince Albert, Sask., July 22, 1916, (Sladen).

Bombus perplexus Cr. Montreal, Que., (Winn).

Psithyrus ashtoni Cr. Truro, N.S., Aug. 25, 1915, (Brittain).

Psithyrus fernaldae Frank. Banff, Alta., July 15, 1915, (Sanson); Quebec, Que., Aug. 8, 1914, (Sladen).

HEMIPTERA.

(Arranged according to a Check List of the Hemiptera—excepting the Aphididæ Aleurodidæ and Coccidæ—of America, north of Mexico, by E. P. Van Duzee; New York Entomological Society, 1916.)

Aphididæ.

Phylloxera querceti Pergande. Vineland, Ont., on oak, Sept. 2, 1916, (Ross).

Phyllaphis quercicola Baker (*querci* Davis). Vineland, Ont., on oak, Sept. 30, 1916, (Ross).

Myzocallis punctatus Monell. Vineland, Ont., on oak, June 4, 1915, (Ross).

Myzocallis discolor Monell. Vineland, Ont., on oak, Sept. 30, 1916, (Ross).

Chaitophorus quercicola Monell. Vineland, Ont., on oak. Oct. 30, 1916, (Ross).

Monellia caryae Monell. Vineland. Ont., on black walnut. Aug. 17, 1916, (Ross).

Macrosiphum crataegi Monell. Vineland. Ont., on hawthorn. Oct. 11. 1916, (Ross).

Macrosiphum pelargonii Kalt. Vineland. Ont., on *Lillium*. Jan. 28. 1916, (Ross).

Myzus circumflexum Buckton. Grimsby. Ont., on *Lillium*, Jan. 1. 1916, (Ross).

Myzus neorosarum Theobald. Vineland. Ont., on *Rosa rugosa*, Aug. 18, Oct. 24, 1916, (Ross).

Myzus rosarum Kalt. Vineland, Ont., on rose, July 26, 1916, (Ross).

Aphis brevis Sanderson. Arkona. Ont., and Vineland, Ont., on hawthorn and apple, Oct. 1916, (Ross).

Aphis bakeri Cowen. Arkona. Ont., and Vineland, Ont., on hawthorn and apple, Oct., 1916, (Ross).

Aphis pseudobrassica Davis. Turnips infested with this species were received at Ottawa, from Sarnia, Ont., on Sept. 9. 1916. This is the first record of this aphid in Ontario, (Gibson).

Van Duzee's Number.

Cydnidæ.

28. *Thyreocoris nitiduloides* Wolff. Brantford. Ont., (record sent by W. H. Brittain).

Pentatomidæ.

87. *Brochymena tenebrosa* Walk. St. Hilaire. Que., May 24. 1916. (Moore).
122. *Euschistus conspersus* Uhl. Departure Bay. Vanc. Is., B.C., July 21. 1913, (Walker).
127. *Euschistus ictericus* Linn. Toronto. Ont., Sept. 12, 1906. (Walker).

Coreidæ.

Corynocoris typhaus distinctus Dall. Toronto. Ont., Sept. 28, 1896, (Walker).

Aradidæ.

379. *Aradus crenatus* Say. St. Hilaire. Que., May 24, 1916. (Moore).
414. *Aneurus inconstans* Uhl. Toronto, Ont., April 18, 1895, May 8, 1914, (Walker).

Lygæidæ.

432. *Oncopeltus fasciatus* Dall. London. Ont., (H. S. Saunders).
477. *Ischnorrhynchus geminatus* Say. Toronto. Ont., Guelph, Ont., (C. A. Good).
588. *Stignocoris rusticus* Fall. Truro, N.S., (C. B. Gooderham).

Stignocoris pedestris. Truro. N.S., (record sent by W. H. Brittain, who stated that Mr. Parshley, who determined the specimen informed him that the species was new to North America.)

589. *Trapezonotus arenarius* Linn. (*agrestis* Fall). Ottawa, Ont., Aug. 23, 1914, (Germain).

Tingididæ.

665. *Physatocheila plexa* Say. St. Hilaire, Que., May 24, (Moore).
666. *Leptoypha mutica* Say. De Grassi Point, Ont., Aug. 11, 1916, (Walker).

Nabidæ.

826. *Nabis limbatus* Dahlb. Toronto, Ont., March 29, 1904, (R. E. Coleman).
827. *Nabis flavomarginatus* Schol. Truro, N.S., (record sent by W. H. Brittain).

Anthocoridæ.

865. *Triphleps tristicolor* White. Vineland, Ont., found preying on *Thrips tabaci*, Aug. 25, 1916, (Ross).
871. *Dufouriellus ater* Duf. Toronto, Ont., April 13, 1895, (Walker).

Miridæ.

922. *Phytocoris lasiomerus* Reut. De Grassi Point, Ont., Aug. 6, 1895; Algonquin Park, Ont., Aug. 14, 1903, (Walker).
979. *Paracalocoris scrupeus* Say. Hamilton, Ont., June 20, 1914, (Walker).
996. *Dichrooscytus suspectus* Reut. Pictou, N.S., July 22, 1914, (Walker).
* *Lygus communis novascotiensis* Knight. Kentville, N.S., Wolfville, N.S., Smith's Cove, N.S., July 6-28, 1915, (Brittain); Can. Ent., XLVIII, 349.
1018. *Lygus belfragii* Reut. Hamilton, Ont., June 20, 1914, (Walker).
1127. *Heterocordylus malinus* Reut. Hamilton, Ont., June 20, 1914, (Walker).
1139. *Ceratocapsus pumilis* Uhl. Truro, N.S., (record sent by W. H. Brittain).
* *Orthotylus cruciatus* Van D. St. Hilaire, Que., July 4, 1907, (Metcalfe); Proc. Cal. Acad. Sci., VI, 119.
1172. *Orthotylus flavosparsus* Sahlbg. St. Catharines, Ont., June 19, 1914, (Walker).

Gerridæ.

1285. *Gerris conformis* Uhl. Kentville, N.S., (record sent by W. H. Brittain).

Saldidæ.

1328. *Saldula interstitialis* Say. Guelph, Ont., (C. A. Good).

Nepidæ.

1382. *Ranatra nigra* H. S. Go-Home Bay, Ont., Aug. 10, 1908, (T. R. Hanley).
1384. *Ranatra brevicollis* Montd. Lonely Lake, Vanc. Is., B.C., July 31, 1913, (Walker).

Cicadidæ.

1523. *Okanagana noveboracensis* Emmons. Toronto, Ont., May 8, 1896, (Walker).

Cercopidæ.

1550. *Aphrophora permutata* Uhl. Departure Bay, Vanc. Is., B.C., Aug. 3, 1913, (Walker).
1553. *Aphrophora signoretii* Fh. Toronto, Ont., July 12, 1914, (Walker).

Membracidæ.

1628. *Telamona declivata* Van D. Rainy River, Ont., July 22, 1913, (Walker).
1635. *Telamona reclivata* Fh. Edmonton, Alta., July 7, 1910, (Carr).
1644. *Telamona querci* Fh. Toronto, Ont., July 16, 1906, (Walker).
1646. *Telamona ampelopsidis* Harr. Toronto, Ont., June 19, 1896, (Walker).

Cicadellidæ.

1795. *Idiocerus lachrymalis* Fh. Toronto, Ont., De Grassi Point, Ont., Aug. 22, 1914, (Walker).
1936. *Acucephalus albifrons* Linn. De Grassi Point, Ont., Aug. 22, 1914, (Walker).
2051. *Deltocephalus configuratus* Uhl. Guelph, Ont., (C. A. Good).
2053. *Deltocephalus sayii* Fitch. Bondville, Que., (Moore).
2181. *Eutettix strobi* Fh. St. Catharines, Ont., June 19, 1914, (Walker).
2228. *Phlepsius irroratus* Say. Toronto, Ont., July 12, 1914, (Walker).
2156. *Athysanus curtisii* Fitch. Bondville, Que., (Moore).
2410. *Empoasca pulchella* G. & B. Pictou, N.S., July 22, 1914, (Walker).

Fulgoridæ.

2545. *Cixius misellus* Van D. De Grassi Point, Ont., Aug. 26, 1914, (Walker).
2673. *Lamenia obscura* Ball. De Grassi Point, Ont., Aug. 24, 1914. (Walker).

Chermidæ.

2822a. *Aphalara veazici metzaria* Crawf. Pictou, N.S., July 22, 1914, (Walker).
2936. *Psyllia floccosa* Patch. Pictou, N.S., July 22, 1914, (Walker).

Orthoptera.

Acridiidæ.

Nomotettix cristatus Scudd. Truro, N.S., (record from W. H. Brittain).

Locustidæ.

Ceutophilus neglectus Scudd. Black Rock, N.S., (record from W. H. (Brittain).

Orchelimum gladiator Brun. Napinka, Man., Sept. 6, 7, 1916, (N. Criddle). Second Manitoba record. This is the species which was re-described by E. M. Walker as *Orchelimum manitobense*. The latter name has been placed in the synonomy by Rehn and Hebard (Trans. Amer. Ent. Soc., XLI, 44). Recorded from Ontario in 1914, Ent. Record.

Odonata.

(Arranged according to Muttkowski's Catalogue of the Odonata of North America. The numbers refer to the pages of the catalogue.)

Coenagrionidæ.

Coenagrion angulatum E. M. Walker. Red Deer, Alta., July 5-21; Innisfail, Alta., July 6. New to Alberta list, (Whitehouse).

Libellulidæ.

125. *Cordulia shurtleffi* Scudd. Red Deer, Alta., June 6-July 5. New to Alberta list, (Whitehouse).
139. *Libellula quadrimaculata* Linn. Red Deer, Alta., June 8-Aug. 6. New to Alberta list, (Whitehouse).
161. *Sympetrum costiferum* Hagen. Red Deer, Alta., Aug. 5-Sept. 30. New to Alberta list, (Whitehouse).
166. *Leucorrhinia borealis* Hagen. Red Deer, Alta., nymph (with teneral), June 18, previously unknown, (Whitehouse).
166. *Leucorrhinia glacialis* Hagen. Red Deer, Alta., July 5. New to Alberta list, (Whitehouse).
167. *Leucorrhinia intacta* Hagen. Red Deer, Alta., June 24-July 20. New to Alberta list, (Whitehouse).
167. *Leucorrhinia proxima* Calvert. Red Deer, Alta., June 17-July 23: New to Alberta list; also the nymph, June 17, previously unknown. (Whitehouse).

THYSANURA.

These insects have, as yet, received but scant attention in Canada. Mr. Chas. Macnamara, of Arnprior, Ont., is keenly interested in the Collembola, and in addition to *Istoma nigra* MacG., mentioned in the 1913 record, he has found on the snow at Arnprior, the following species:

Isotoma palustris Müller. Dec. and Jan.
Isotoma viridis riparia Nicolet. March.
Entomobrya multifasciata Tull. Dec.
Tomocerus flavescens americanus Schött. Dec.
Achorutes socialis Uzel. All winter.
Achorutes armatus Nicolet. Dec.

In a paper entitled "North American Collembolous Insects of the Subfamilies Achorutinæ, Neanurinæ and Podurinæ," by Dr. J. W. Folsom, the following species from Canada is described:

* *Achorutes pseudarmatus* Folsom. Kaslo, B.C., (Cockle); Proc. U.S.N.M., Vol. 50, p. 490.

SIPHONAPTERA.

The following species were determined by the Hon. N. Charles Rothschild:

Ceratophyllus arctomys Baker. Perce, Que., from ground hog, June 19, 1915, (Taverner).

Ceratophyllus bruneri Baker. Aweme, Man., Jan. 15, 1914, from *Taxidea taxus*, (S. Criddle).

Ceratophyllus agilis Roths. Aweme, Man., Feb., 1915, from *Mustela cicognanii*, (S. Criddle).

Ctenocephalus canis. Ottawa, Ont., Oct. 27, 1915, (Hewitt).

Leptopsylla hygini Roths. Aweme, Man., Feb., 1915, from *Mustela cicognanii*, (S. Criddle).

Araneida.

(Arranged according to Banks' Catalogue of Nearctic Spiders, U.S.N.M., Bull. 72. The numbers refer to the pages in the catalogue.)

During the past year Mr. J. H. Emerton, of Boston, has examined many spiders collected in Canada. The collection at the University of Toronto, largely the work of Prof. E. M. Walker and Mr. T. B. Kurata, was studied. This collection contains 110 species from widely separated localities. Collections made at Toronto by Mrs. A. B. Faull and from the Thousand Islands by Miss H. Coleman were also determined by Mr. Emerton. In June, 1916, Mr. Emerton visited Ottawa and the writer spent many happy hours in his company collecting spiders, etc. While in Ottawa he examined the collection in the Entomological Branch, and identified a number of species. After leaving Ottawa, Mr. Emerton made collections at Montreal and Quebec, south to Sherbrooke and Megantic and northward to Maniwaki, Montford and Lake St. John, 92 species in all being taken. Mr. F. W. Waugh, of the Geological Survey, Ottawa, collected 46 species at Long Lake, 60 miles east of L. Nipigon and on Manitoulin Island, Lake Huron.

Many of the records given below refer to well known species, but it seems worth while including them here, as the definite localities add to their known range of distribution.

In the Proceedings of the United States National Museum, Vol. 51, pages 67-72 (separates issued Oct. 16, 1916), Nathan Banks published a list of 51 species of spiders collected by Messrs. Currie, Caudell and Dyar, in British Columbia in 1903.

Theraphosidæ.

2. *Brachybothrium pacificum* Simon. Saanich, B.C., (Wilson), Departure Bay, Vanc. Is., 1913, (T. B. Kurata).

Scytodidæ.

5. *Scytodes thoracica* Lat. Toronto, Ont., Sept. 15, 1915, (T. B. Kurata).

Dysderidæ.

7. *Segestria pacifica* Bks. Departure Bay, Vanc. Is., B.C., 1913, (T. B. Kurata).

Drassidæ.

9. *Gnaphosa conspersa* Thor. Lanoraie, Que., June 20, 1915, (Beaulne); Prince Albert, Sask., June 25, 1913, (T. B. Kurata); Departure Bay, Vanc. Is., July 18-28, 1913, (T. B. Kurata).
9. *Gnaphosa parvula* Bks. Prince Albert, Sask., June 25, 1913, (T. B. Kurata); Dauphin, Man., June, 1913, (T. B. Kurata).
9. *Pythonissa imbecilla* Keys. Chelsea, Que., June, 1916, (Gibson).
10. *Drassus neglectus* Keys. Lanoraie, Que., June 14, 1915; Montreal, Que., May 9, 1915, (Beaulne); Orillia, Ont., June 11-16, 1914; Sudbury, Ont., June 17, 1913, (T. B. Kurata); Departure Bay, Vanc. Is., B.C., July 21, 1913, (T. B. Kurata).
10. *Drassodes robustus* Emer. Departure Bay, Vanc. Is., B.C., (T. B. Kurata); Banff, Alta., June 29, 1913, (T. B. Kurata).

Clubionidæ.

10. *Micaria gentilis* Banks. Montreal, Que., May 8, 1915, (Beaulne).
11. *Castianeira crocata* Hentz. Lanoraie, Que., June 14, 1915, (Beaulne).
12. *Agræca pratensis* Emer. Lanoraie, Que., June 21, 1915, (Beaulne).
14. *Clubiona canadensis* Emer. Montreal, Que., May 11, 1915, (Beaulne); Nipigon, Ont., June 18, 1913, (T. B. Kurata); Metlakatla, B.C., 1912, (J. H. Keen); Departure Bay, B.C., (T. B. Kurata); Dauphin, Man., June 21, 1913, (T. B. Kurata).
14. *Clubiona riparia* Koch. Toronto, Ont., (T. B. Kurata).

Agelenidæ.

15. *Cicurina simplex* Simon. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
15. *Cicurina tersa* Simon. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
16. *Cœlotes montanus* Emer. Orillia, Ont., April 27, 1914; Toronto, Ont., May 8, 1914, (T. B. Kurata).
16. *Agelena pacifica* Banks. Saanich, B.C., (Wilson).

Dictynidæ.

17. *Dictyna maxima* Bks. Dauphin, Man., June, 1913, (T. B. Kurata).
18. *Amaurobius sylvestris* Emer. Banff, Alta., end June, 1913, (T. B. Kurata); Aylmer, Que., June 5, 1915, (Beaulne); Nipigon, Ont., July, 1894, (W. McInnes); Orillia, Ont., May 24, 1914, (T. B. Kurata).
19. *Amaurobius ferox* Walck. Montreal, Que., April 21, 1915, (Beaulne).
19. *Amaurobius severus* Simon. Departure Bay, Vanc. Is., B.C., July 5, 1913, (T. B. Kurata).

Theridiidæ.

19. *Theridium murarium* Emer. Prince Albert, Sask., June 25, 1913, (T. B. Kurata).
20. *Theridium zelotypum* Emer. Manitoulin Island, (F. W. Waugh); Nipigon, Ont., June 18, 1913, (T. B. Kurata); Ottawa, Ont., June, 1916, (J. H. Emerton); Meach Lake, Que., Hull, Que., (Emerton and Gibson).
21. *Lithyphantes corollatus* L. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
21. *Enoplognatha marmorata* Hentz. Departure Bay, Vanc. Is., B.C., (T. B. (Kurata); Prince Albert, Sask., June 25, 1913, (T. B. Kurata).
21. *Crustulina borealis* Bks. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
21. *Crustulina guttata* Reuss. Montreal, Que., May 6, 1915, (Beaulne); Ahuntsic, Que., June 4, 1915, (Beaulne).
22. *Asagena americana* Emer. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
23. *Lathrodectes mactans* Fab. Nipigon, Ont., July, 1894, (W. McInnis); Departure Bay, Vanc. Is., B.C., July 6, 1913, (T. B. Kurata).
27. *Lophocarenum decemoculatum* Emer. Aylmer, Que., June 3, 1915, (Beaulne); Lanoraie, Que., June 25, 1915, (Beaulne).
29. *Grammonota pictilis* Camb. Southern Labrador, 1915, (C. W. Townsend).
31. *Erigone longipalpis* Sund. Metlakatla, B.C., 1912, (Keen).

Linyphiidæ.

32. *Neriene clathrata* Sund. Toronto, Ont., (T. B. Kurata).
32. *Labulla altioculata* Keys. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).

33. *Linyphia diana* Keys. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).
33. *Linyphia litigiosa* Keys. Departure Bay, Vanc. Is., B.C.. July, (T. B. Kurata).
33. *Linyphia mandibulata* Emer. Prince Albert, Sask., June 25, 1913, (T. B. Kurata).
33. *Linyphia nearctica* Banks. Nipigon, Ont., (F. W. Waugh). The occurrence of this interesting species at Nipigon extends its range 700 miles further west. It frequents small spruce and balsam trees, (J. H. E.). During Mr. Emerton's visit to Canada in 1916 the species was found at several points in the Ottawa district, (A. G.).
34. *Bathyphantes calcaratus* Emer. Old Romain to Blanc Sablon, Southern Labrador, 1915, (C. W. Townsend).
35. *Bathyphantes subalpina* Emer. Old Romain to Blanc Sablon, Southern Labrador, 1915, (C. W. Townsend).

Tetragnathidæ.

36. *Eucta caudata* Emer. Prince Albert, Sask., (T. B. Kurata).
37. *Tetragnatha vermiformis* Emer. Jordan, Ont., Sept. 24, 1915, (Ross); Toronto, Ont., (T. B. Kurata).
37. *Tetragnatha extensa* Linn. Nipigon, Ont.. 1894, (W. McInnis); Hull, Que., June, 1916, (Gibson); Aylmer, Que., June 5, 1915, (Beaulne); Lanoraie, Que., June 24, 1915, (Beaulne).

Epeiridæ.

39. *Zilla montana* Koch. Nipigon, Ont., June 18, 1913, (T. B. Kurata).
41. *Epeira cavatica* Keys. Toronto, Ont., (T. B. Kurata).
42. *Epeira gemma* McCook. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).

Thomisidæ.

48. *Xysticus formosus* Banks. Banff, Alta., end June, (T. B. Kurata); Prince Albert, Sask., June, 1913, (T. B. Kurata).
48. *Xysticus limbatus* Keys. Meach Lake, Que., June 22, 1916, (Gibson); Dauphin, Man., June, 1913, (T. B. Kurata).
51. *Thanatus coloradensis* Keys. Departure Bay, Vanc. Is., B.C., (T. B (Kurata).
51. *Tibellus oblongus* Walck. Spruce Brook, Nfd., July 26, 1914, (Walker); Okanagan Landing, B.C., Aug. 15, 1913, (T. B. Kurata); Prince Albert, Sask., June, 1913, (T. B. Kurata).
52. *Philodromus inquisitor* Thor. Southern Labrador, 1915, (C. W. Townsend).

Pisauridæ.

53. *Dolomedes idoneus* Mont. Chelsea, Que., May, 1913, (Gibson); De Grassi Point, Ont., Aug. 26, 1911, (Walker).

Lycosidæ.

55. *Lycosa albohastata* Emer. North Devon Island, Hudson Bay, Aug. 13, 1904, (A. Halkett).
55. *Lycosa beani* Emer. Southern Labrador, 1915, (C. W. Townsend).

57. *Geolycosa missouriensis* Banks. Aweme, Man., (J. Fletcher). Burrows in sand and occurs along the Great Lakes and south as far as Texas, (J. H. E.).

58. *Pardosa atra* Bks. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).

58. *Pardosa diffusa* Emer. Southern Labrador, 1915, (C. W. Townsend); Aylmer, Que., June 5, 1915, (Beaulne): Toronto, Ont., (T. B. Kurata); Fort William, Ont., June 19, 1913, (T. B. Kurata): Banff, Alta., end June, (T. B. Kurata).

59. *Pardosa grœnlandica* Thor. Klutlan Glacier, 9,000 feet, June, 1893, (F. H. Lambert); Jasper Park, Alta., Sept. 1, 1915, (Hewitt); District of Mackenzie along the south shore of Great Slave Lake, Aug. 22, 1914, (F. Harper): Departure Bay, B.C., (T. B. Kurata); Prince Albert, Sask., June 25, 1913, (T. B. Kurata).

59. *Pardosa lapidicina* Emer. St. Johns, Que., March 23; Vaudreuil, Que., May 27: Lanoraie, Que., June 24, 1915, (Beaulne): Toronto, Ont., Oct. 4, 1913, (T. B. Kurata).

59. *Pardosa glacialis* Thor. District of Mackenzie along the south shore of Great Slave Lake, Aug. 22, 1914, (F. Harper): Toronto, Ont., May 8, 1914, (T. B. Kurata); Prince Albert, Sask., June 25, 1913, (T. B. Kurata).

59. *Pardosa uncata* Thor. Departure Bay, Vanc. Is., B.C., (T. B. Kurata); Dauphin, Man., June, 1913, (T. B. Kurata): Banff, Alta., end June, 1913, (T. B. Kurata).

61. *Pirata insularis* Em. Toronto Island, Ont., June 10, 1914, (T. B. Kurata).

Attidæ.

62. *Phidippus albovittatus* Koch. Chelsea, Que., June, 1916, (Gibson).

64. *Phidippus johnsoni* Peck. Departure Bay, Vanc. Is., B.C., Aug. 1, 1913, (T. B. Kurata).

66. *Dendryphantes flavipedes* Peck. Prince Albert, Sask., June, 1913, (T. B. Kurata).

66. *Dendryphantes militaris* Hentz. Mr. Emerton informs me that Prof. W. H. Brittain, of Truro, N.S., has sent to him specimens of this familiar spider which has several times been seen eating the adults of the Apple Maggot.

68. *Pellenes oregonensis* Peck. Departure Bay, Vanc. Is., B.C., (T. B. Kurata).

70. *Sittacus ranieri* Peck. Banff, Alta., June 28, 1913, (T. B. Kurata).

71. *Icius harti* Emer. Lanoraie, Que., June 21, 1915: Aylmer, Que., June 5, 1915, (Beaulne).

INDEX

Forty-Eighth Annual Report

OF THE

Entomological Society

OF ONTARIO

1917

(PUBLISHED BY THE ONTARIO DEPARTMENT OF AGRICULTURE)

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by A. T. WILGRESS, Printer to the King's Most Excellent Majesty
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Printed by
WILLIAM BRIGGS,
Corner Queen & John Sts.,
Toronto.

To His Honour, SIR JOHN STRATHEARN HENDRIE, a Lieutenant-Colonel in the Militia of Canada, etc., etc., etc.,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned begs to present for the consideration of your Honour, the Report of the Entomological Society for 1917.

Respectfully submitted,

WILLIAM H. HEARST,

Minister of Agriculture.

Toronto, 1918.

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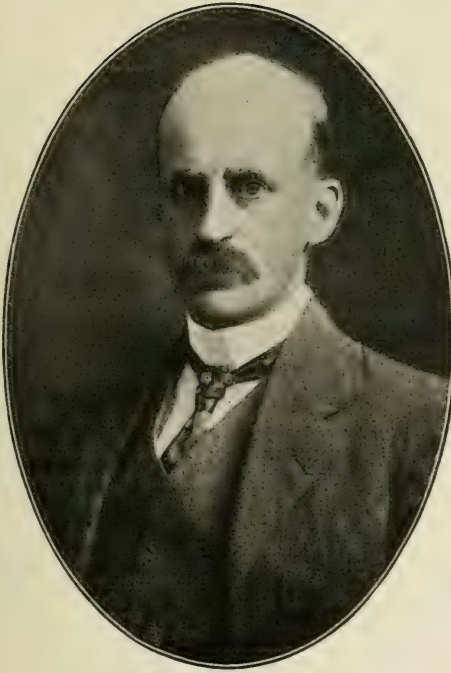


Mr. Albert F. Winn,
President of the Entomological Society of Ontario, 1915-1917.

Entomological Society of Ontario

OFFICERS FOR 1917-1918

President—PROF. LAWSON CAESAR, Dept. of Entomology, Ontario Agricultural College. Guelph.

Vice-President—MR. ARTHUR GIBSON, Division of Entomology, Ottawa.

Secretary-Treasurer—MR. A. W. BAKER, B.S.A., Lecturer in Entomology, O. A. College. Guelph.

Curator—MR. ERIC HEARLE, O. A. College, Guelph.

Librarian—REV. PROF. C. J. S. BETHUNE, M.A., D.C.L., F.R.S.C., Professor of Entomology and Zoology, O. A. College, Guelph.

Directors—Division No. 1, MR. J. M. SWAINE, Entomological Branch, Dept. of Agriculture, Ottawa; Division No. 2, MR. C. E. GRANT, Orillia; Division No. 3, DR. A. COSENS, Parkdale Collegiate Institute, Toronto; Division No. 4, MR. F. J. A. MORRIS, Peterborough; Division No. 5, MR. J. W. NOBLE, Essex, Ont.; Division No. 6, MR. W. A. ROSS, Vineland Station, Ont.

Directors (ex-Presidents of the Society)—REV. PROF. C. J. S. BETHUNE, M.A., D.C.L., F.R.S.C., Guelph; W. HAGUE HARRINGTON, F.R.S.C., Ottawa; PROF. JOHN DEARNESS, Vice-Principal, Normal School, London; REV. THOS. W. FYLES, D.C.L., F.L.S., Ottawa; PROF. WM. LOCHHEAD, B.A., M.S., Macdonald College, Que.; JOHN D. EVANS, C.E., Chief Engineer, Central Ontario Railway, Trenton; PROF. E. M. WALKER, B.A., M.B., F.R.S.C., University of Toronto; C. GORDON HEWITT, D.Sc., F.R.S.C., Dominion Entomologist, Ottawa; MR. ALBERT F. WINN, Westmount, Que.

Editor of "The Canadian Entomologist"—PROF. E. M. WALKER, Toronto.

Delegate to the Royal Society of Canada—THE PRESIDENT.

FINANCIAL STATEMENT

For year ending October 31st, 1917.

Receipts.		*Expenditures.*	
Cash on hand, 1915-16	$27 58	Printing due on 1915-16	$66 96
Advertisements	53 80	Annual meeting	124 35
Back numbers	231 88	Printing	1,221 90
Cork and pins	100 43	Salaries	225 00
Dues	80 65	Library	24 00
Subscriptions	471 73	Expense	41 27
Government grant	1,000 00	Bank exchange	10 21
Bank interest	14 81	Cork and pins	103 59
		Annual report	121 50
		Cash on hand	42 10
	$1,980 88		$1,980 88

To balance due on printing	$104 14
By cash on hand	42 10
Net deficit	$62 04

Auditors: L. Caesar.
J. E. Howitt.

Respectfully submitted,

A. W. BAKER,

Secretary-Treasurer.

LIST OF MEMBERS

Ontario.

Andrews, H. D. ....Toronto.
Astwood, J. C. ....Port Arthur.
Baker, A. W. ....Guelph.
Beaulne, J. I. .... Ottawa.
Biggar, W. E. ....Hamilton.
Brimley, J. F. ....Bloomfield.
Brobst, C. K. ....Toronto.
Burrows, A. R. ....Guelph.
Caesar, Prof. L. .... "
Calvert, J. F. ....London.
Chrystal, R. Neil ....Ottawa.
Cleeves, A. C. ....Guelph.
Clemens, W. A. ....Toronto.
Cosens, Dr. A. .... "
Craigie, E. H. .... "
Crawford, H. G. ....Wilton Grove.
Curran, H. ....Guelph.
Dearness, Prof. J. ....London.
Doherty, T. K. ....Ottawa.
Duff, G. H. ....Hamilton.
Dunlop, James ....Woodstock.
Fouse, C. M. ....Toronto.
Gibson, Arthur ....Ottawa.
Gooderham, C. B. .... "
Grant, C. E. ....Orillia.
Grant, L. J. M. .... "
Hahn, Paul ....Toronto.
Haight, D. H. ....Sudbury.
Hannibal, J. ....Toronto.
Hearle, E. ....Guelph.
Hewitt, Dr. C. Gordon ... Ottawa.
Huntsman, Dr. A. G. ....Toronto.
James, L. E. ....St. Thomas.
Jolly, Miss ....Toronto.
King, Lieut. Vernon .....Guelph.
Kirkwood, K. ....Toronto.
Kitto, V. ....Ottawa.
Kurata, T. B. ....Toronto.
Logier, S. .... "
Macnamara, C. ....Arnprior.
Morris, F. J. A. ....Peterborough.
Mossop, Miss B. K. E. ....Toronto.
Nash, C. W. .... "
Noble, J. W. ....Essex.
Petch, C. E. ....Ottawa.
Ross, W. A. ....Vineland.
Rowland, H. F. ....Guelph.
Saxby, J. W. ....Toronto.
Shorey, W. P. .... Vineland Sta.
Sladen, F. W. L. ....Ottawa.
Smith, Arthur ....Toronto.
Snazelle, C. .... "
Spencer, Capt. G. J. ......Guelph.
Swaine, J. M. ....Ottawa.
Strickland, E. H. .... "
Thompson, J. W. ....Toronto.
Tomlinson, A. H. ....Guelph.
Walker, Prof. E. M. ......Toronto.
Watson, Dr. A. H. R......Port Hope.
White, James ....Snelgrove.
Williams, G. A. ....Port Hope.
Wright, Capt. W. H. .....Guelph.
Zavitz, E. J. ....Toronto.

Quebec.

Barwick, E. C. ....Montreal.
Burgess, Dr. T. J. W......Verdun.
Chambers, C. ....Montreal.
Chapais, J. C. ....St. Denis.
Chagnon, G. ....Montreal.
Clayson, G. H. .... "
Corcoran, J. A. .... "
Cummings, R. F. .... "
Davis, M. W. ....Westmount.
Dunlop, G. C. ....Montreal.
Du Porte, E. M. ....Macdonald College.
Garland, C. ....Montreal.
Germain, Bro. ....Three Rivers.
Gibb, L. ....Montreal.
Hall, G. H. .... "
Holmes, J. G. ....Westmount.
Huard, Rev. V. A. ....Quebec.
Jackson, Dr. F. S. ....Montreal.
Leopold, Rev. Father.....La Trappe.
Letourneau, F. .... Oka.
Lochhead, Prof. W. ......Macdonald College.
Moore, G. A. ....Montreal.
Southee, G. A. .... "
Winn, A. F. ....Westmount.

New Brunswick.

Tothill, J. D. ....Fredericton.
Baird, A. B. .... "

Nova Scotia.

Allen, E. Chesley ....Yarmouth.
Baird, W. W. ....Nappan.
Blair, W. S. Kentville.
Brittain, Prof. W. H......Truro.
De Wolfe, L. A. .... "
Dustan, A. G. ....Bridgetown.
Good, C. A. ....Truro.
Harlow, L. C. .... "
Lindsay, Harriet E. ...... "
Longley, Miss M. ....Paradise.
McKay, Dr. A. H. ....Halifax.
Payne, H. G. ....Granville Ferry.
Payne, S. H. .... "
Perrin, Joseph ....Halifax.
Sanders, G. E. ....Bridgetown.
Scott, Prof. J. M. ....Truro.
Wetmore, Ralph ....Yarmouth.
Whitman, C. F. U. ......Lawrencetown.
Young, Ermina ....Brighton.

Manitoba.

Brooker, S. H. ....Winnipeg.
Criddle, Norman ....Treesbank.
Hippesley, Mrs. W. W....Dauphin.
Hunter, Dr. A. J. ....Teulon.
Wallis, J. B. ....Winnipeg.

SASKATCHEWAN.

Androchowicz, E. .... Humboldt.
Bentley, Miss L. .... Mellville.
Hutchinson, H. .... Starblanket.
Neville, S. J. .... Cottonwood.
Willing, Prof. T. N. ...... Saskatoon.

ALBERTA.

Antijutti, Miss E. .... Barons.
Baird, Thomas .... High River.
Bentley, Lettice .... Lethbridge.
Bowman, K. .... Edmonton.
Carr, F. S. .... "
Dod, F. H. Wolley .... Midnapore,
Henderson, Mrs. L. A. ... Barons.
Imeson, Miss V. .... "
Mackie, Donald .... Edmonton.
Phillips, E. .... Lacombe.
Whitehouse, F. C. .... Red Deer.

BRITISH COLUMBIA.

Blackmore, E. H. .... Victoria.
Brewn, W. A. .... "
Brinkman, M. .... "
Buckell, W. N. .... Salmon Arm.
Cameron, Dr. A. E. ...... Agassiz.
Carter, W. R. .... Victoria.
Cockle, J. W. .... Kaslo.
Cunningham, C. .... Victoria.
Day, G. O. .... Duncan's, V.I.
Downes, N. .... Victoria.
Evans, H. H. .... Vernon.
French, P. E. .... Salmon Arm.
Garrett, C. B. D. .... Cranbrook.
Hadwen, Dr. S. .... Agassiz.
Hanham, A. W. .... Duncan's Station.
Harris, Miss M. .... Deroche.
Hook, G. .... Cobble Hill.
Hugh, G. W. .... Victoria.
Johnstone, W. B. .... Edgewood, Arrow Lake.
Kermode, F. .... Victoria.
Leach, D. H. .... Salmon Arm.
Mathers, G. W. .... Vancouver.
McKeever, F. W. .... Penticton.
Phair, A. W. A. .... Lillooet.
Robson, A. C. U. .... Victoria.
Ruhman, M. .... Vernon.
Stevens, M. G. .... Vancouver.
Taylor, L. E. .... Kelowna.
Treherne, R. C. .... Agassiz.
Venables, E. P. .... Vernon.
Warren, Miss E. .... Barnston Island.
White, E. W. .... Victoria.

HONORARY MEMBERS

Cockerell, Prof. T. D. A... Boulder, Col.
Comstock, Prof. J. H. .... Ithaca, N.Y.
Cresson, Ezra T. .... Philadelphia, Pa.
Felt, Dr. E. P. .... Albany, N.Y.
Howard, Dr. L. O. ...... Washington, D.C.
Wickham, Prof. H. F. .... Iowa City, Ia.

LIFE MEMBERS

Bethune, Rev. C. J. S..... Professor of Entomology, Ontario Agricultural College, Guelph.
Evans, John D., C.E...... Trenton.
Fyles, Rev. Dr. T. W. .... Ottawa.

MEMBERS OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO ON ACTIVE SERVICE

Bird, M. L. .... Prince Rupert, B.C.
Brewn, L. A. .... Victoria, B.C.
Brodie, H. S. .... Dom. Ent. Lab., Agassiz, B.C.
Burrows, A. R. .... O.A.C., Guelph.
*Bush, A. H. .... Vancouver, B.C.
Cleeves, A. C. .... O.A.C., Guelph.
Creese, H. H. .... Kelowna, B.C.
Curran, H. .... Dom. Ent. Lab., Vineland, Ont.
Dickie, C. M. .... Kentville, N.S.
Dod, F. H. Wolley .... Midnapore, Alta.
Good, Lieut. C. A. .... Truro, N.S.
*Harvey, R. V. .... Victoria, B.C.
Hudson, H. F. .... Entomological Br., Ottawa.
King, V. .... Bureau of Entomology, Washington, D.C.
Martin, A. .... South Vancouver, B.C.
Matheson, J. B. ...... Kelowna, B.C.
McCubbing, C. .... Salmon Arm, B.C.
Neville, S. J. .... Cottonwood, Sask.
Prewett, F. J. .... Toronto, Ont.
Rive, Henry .... Victoria, B.C.
Robertson, W. H. ..... "
Robson, A. B. V. ..... "
Rowland, H. F. .... O.A.C., Guelph.
Simms, H. M. .... Montreal, P.Q.
Snazelle, Chas. .... Thornloe, New Ontario.
Spencer, Capt. G. J. .. O.A.C., Guelph.
Strickland, E. H. ..... Entomological Br., Ottawa.
Venables, E. P. .... Vernon, B.C.
*Walsh, Lieut. F. W. . O.A.C., Guelph.
Williams, C. M. .... Nappan, N.S.
Wilson, Ed. .... Vancouver, B.C.
Wright, Lieut. W. H... O.A.C., Guelph.

*Killed in action.

Entomological Society of Ontario

ANNUAL MEETING

The Fifty-fourth Annual Meeting of the Society was held at Macdonald College, Ste. Anne de Bellevue, Que., on Thursday and Friday, Nov. 8th and 9th. The chair was occupied by the President, Mr. A. F. Winn.

The following members were present: Dr. C. Gordon Hewitt and Messrs. Arthur Gibson, J. M. Swaine and J. I. Beaulne, Ottawa; Messrs. A. F. Winn and G. A. Moore and Dr. J. A. Corcoran, Montreal; Prof. Wm. Lochhead and Mr. E. M. du Porte, Macdonald College; Mr. Geo. Maheux, Quebec; Mr. J. C. Chapais, St. Denis-en-bas, Que.; Father Leopold and Mr. F. Letourneau, La Trappe, Que.; Mr. R. F. Cummings, Maissoneuve, Que.; Mr. J. D. Evans, Trenton, Ont.; Prof. L. Caesar and Mr. A. W. Baker, O. A. College, Guelph; Mr. F. J. A. Morris, Peterborough; Mr. W. A. Ross, Vineland Station, Ont.; Mr. H. F. Hudson, Strathroy, Ont.; Prof. W. H. Brittain, Truro, N.S.; and Messrs. A. L. McLaine and C. E. Petch, Fredericton, N.B.

Others present were Prof. Arthur Willey, Montreal; Dr. F. C. Harrison, Professors T. G. Bunting and Jas. Murray, and Mr. W. P. Fraser, Macdonald College; Mr. J. H. Emerton, Boston, Mass.; Dr. T. J. Headlee, New Brunswick, N.J.; Mr. A. F. Burgess, Melrose Highlands, Mass.; and Prof. W. C. O'Kane, Durham, N.H.

On Thursday morning a meeting of the Council was held in the office of Prof. Lochhead, at which the report of the proceedings during the past year and the financial statement were received and adopted. It was decided that all payments for articles contributed to the Annual Report be discontinued. The Council also decided that the next Annual Meeting be held at the Ontario Agricultural College, Guelph.

In the afternoon the Society met in the Biology Building, and the meeting was called to order by the President. After the reading of the reports of the Council, Treasurer, Librarian and Curator and of the various branches of the Society, the local Secretary, Prof. Lochhead, read a letter from Dr. Hewitt expressing regret at his inability to attend all the meetings. Letters of regret were also read from a number of entomologists from the United States.

At the close of the afternoon session telegrams were sent to Dr. Bethune and Dr. Fyles, conveying to them the Society's greetings and good wishes and expressing regret at their absence from the meeting.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1916-1917.

The Fifty-third Annual Meeting of the Society was held at the Ontario Agricultural College, Guelph, on Thursday and Friday, November 2nd and 3rd, 1916. The President of the Society, Mr. A. F. Winn, Westmount, P.Q., occupied the chair. There was a very satisfactory attendance of members and students; among the visitors from a distance may be mentioned Dr. L. O. Howard, Chief

of the Bureau of Entomology, Washington, D.C., and Professor Parrott, Geneva, N.Y. A large number of papers of interest and importance were read and discussed, of which the following is a list: "The Naturalist in the City," by the Rev. Dr. T. W. Fyles; "Dusting Fruit-trees and Grapes for the Control of Biting Insects and Diseases," by Prof. L. Caesar; "General Notes on Aphids which Occur on Apple-trees," by Mr. W. A. Ross; "Further Experiments with the Green Apple Bug," by Prof. W. H. Brittain; "Notes on Physonota unipuncta, the Sunflower Tortoise-beetle," by Mr. A. F. Winn; "Preliminary Notes on the use of Repellents for Horn-flies and Stable-flies on Cattle," by Mr. A. W. Baker; "The Wood of Desire," by Mr. F. J. A. Morris; "Insects as Material for Studies in Heredity," by Prof. W. Lochhead; "The Migratory Tendency in Dragonflies," by Prof. E. M. Walker; "The History of the Forest Tent-Caterpillar and Fall Webworm in North America," by Mr. A. B. Baird; "Three Important Greenhouse Pests recently introduced into Canada," by Mr. A. Gibson; "Camp Hygiene," by Capt. G. J. Spencer; "Experiments in the Control of the Apple Maggot," by Prof. W. H. Brittain; "Summary of Experiments on the Control of Locusts by Coccobacillus acridiorum d'Herelle," by Messrs. E. M. du Porte and J. Vanderleck; "Three Shade-tree Insects," by Mr. J. M. Swaine; "Notes on Some Insects of the Season," by Prof. L. Caesar; and "Parasites of the Larch Saw-fly," by Dr. C. Gordon Hewitt.

The Canadian Entomologist, the official organ of the Society, has been regularly issued each month; the 48th volume was completed in December, 1916. It contained 437 pages and was illustrated with 13 full-page plates and 21 original figures in the text. The contributors of papers numbered 55 and included writers in Ontario, Quebec, Nova Scotia, Manitoba, Alberta, fourteen of the United States, and London, England. The series of interesting and instructive papers on "Popular and Practical Entomology" was continued each month. During the year, 155 new species, subspecies and varieties, and 42 new genera were described, a much larger number than usual. These systematic and descriptive papers render the magazine indispensable to workers in various fields of scientific entomology and cause a constant application for back numbers and volumes.

The attendance of students at military drill during the afternoons when the daily lectures were over prevented most of the members of the society in Guelph from coming to meetings; few, therefore, were held during 1916-17, and those were mostly of a business character, at which thirty new members were elected. The following papers, however were read during the year:

"Some Ontario Mosquitoes," by Eric Hearle.

"The Colorado Potato Beetle," by A. W. Guild.

"Lady-bird beetles," by R. M. Aiton.

Year by year it becomes our sad duty to record the loss and pay tribute to the memory of departed members of our Society. On the 18th of November, 1916, Mr. Edmund Baynes Reed died at Victoria, B.C., after a long illness. He was one of the original members of the Society when it was formed in 1863, and for twenty-five years filled various offices with great industry and enthusiasm. He was largely instrumental in establishing our library and assisted greatly in building up the Society's collections of Canadian insects. His removal to British Columbia in 1890 was a distinct loss to the Society, though he continued to take great interest in its welfare. An appreciative obituary notice by his lifelong friend, Dr. Bethune, was published in the February, 1917, number of the *Canadian Entomologist*. Another of our British Columbian members has been removed

from us owing to the tragic death of Mr. Tom Wilson, who lost his life on March 6th in a fire that destroyed the Quaballa Hotel at Hope, B.C. He was engaged at the time in his work of inspecting and improving the orchards on the Indian reserves. He was President of the British Columbia Branch of our Society in 1912 and always took a very active interest in its proceedings. He possessed a remarkable knowledge of the trees, plants and insects of the Province, and had made a large collection of the latter, which he presented to the Canadian national cabinets in charge of the Entomological Division at Ottawa. An interesting sketch of his life by Dr. C. Gordon Hewitt, was published in the *Canadian Entomologist* for August. We have also to record with much regret the sudden death of Mr. A. H. Kilman, of Ridgeway, Ont., who had been a member of the Society for a great many years. He formed a large and valuable collection of Coleoptera which is now in the possession of the Ontario Agricultural College at Guelph.

On Tuesday of this week another of our members has been removed from us in the person of Mr. S. T. Wood, who died in Toronto after a few weeks' illness, in the 57th year of his age. He was for many years on the editorial staff of *The Globe* newspaper, and was widely known as the writter of numerous sketches of the various aspects of nature at all seasons of the year. Many of these were collected together and recently published in a beautifully illustrated volume "The Rambles of a Canadian Naturalist." They form a series of charming papers on wild animal life, birds and insects, flowers, trees and shrubs, observed in the neighborhood of Toronto in groves and ravines which the hand of man has not yet disturbed.

REPORT OF THE LIBRARIAN.

As there were no funds available for the purpose, no books were purchased nor was any binding done during the year ending on October 31st, 1917; there is very little, therefore, to report. Only nine bound volumes were placed upon the shelves, making the total number on the register 2,271; the unbound material, consisting of bulletins, reports, periodicals and pamphlets, continues to increase and, it is hoped, may some day be put in proper shape and made available for convenient reference.

CHARLES J. S. BETHUNE, *Librarian.*

REPORT OF THE CURATOR.

The collections of the Society during the past year have been carefully and regularly examined, and precautions have been taken to prevent injury by museum pests.

Professor T. D. A. Cockerell, of the University of Colorado, Boulder, Col., very kindly sent a number of specimens of bees, and wrote that he had read with great interest Dr. Bethune's account of the collections of our Society. He also said that when the collection was exhibited in London at the Fisheries Exhibition in 1882, he examined it very carefully and made many notes; it was the first

collection of North American insects that he had ever seen, and it interested him very much in comparison with the British fauna.

Few other additions have been made to the collections this year, and any presentations, especially of Diptera and Hemiptera would be gratefully received.

Respectfully submitted,

W. G. Evans, *Curator.*

REPORT OF THE MONTREAL BRANCH.

The 369th regular and 44th Annual Meeting of the Montreal Branch of the Entomological Society of Ontario was held at the residence of Geo. A. Moore, 359 Quebec St., Outremont, on Saturday evening, May 12th, 1917, at 8.15 p.m.

The report of the Council showed that during the season 1916-1917, eight meetings were held with a total attendance of 98 or an average of over 12 per meeting. This is the largest attendance on record since 1874-5 when it totalled 100; that year the average attendance was only 7. The largest average attendance on record formerly was for the season 1898-9 when it was slightly over 10 per meeting. The large attendance this year was due to two special meetings held: one in the Redpath Museum when Dr. Jackson gave a lantern lecture and the other at the Loyola College when a number of the pupils were present.

We report the death of one of our oldest members, the late Albert Griffin.

During the season the following papers and talks were given before our Society:—

1. President's Annual Address .... A. F. Winn.
2. Notes on Physonota unipuncta (Col.) .... A. F. Winn.
3. Habits and life history of Nymphula maculalis Chem. ...... Dr. F. S. Jackson.
4. Collecting Wasps and Bees .... F. W. L. Sladen.
5. Hemiptera taken at St. Hilaire, Que., on May 24th, 1916..... Geo. A. Moore.
6. Diurnal Moths taken at Vaudreuil, Que. .... Dr. J. A. Corcoran.
7. The Season, 1916 .... L. Gibb.
8. Belostomatidæ .... Geo. A. Moore.
9. Description of Annual Meetings of the American Entomological and Washington Societies .... Dr. Corcoran.
10. Insects Attacking Apple Orchards at Covey Hill and Hemmingford in 1916 .... J. I. Beaulne.
11. Leaf-cutting Ants .... Dr. F. S. Jackson.
12. Chinch Bugs .... Geo. A. Moore.
13. The Study of Insects. Some Practical and Theoretical Aspects of Entomology .... Dr. F. S. Jackson.
14. Sex Characteristics of the Nymphalidæ .... G. Chagnon.
15. The Making of Lantern Slides .... Dr. Corcoran.
16. Insects in Shore Drift (Hemiptera) .... Geo. A. Moore.
17. Dimorphism in the Genus Grapta .... A. F. Winn.

The Treasurer's report showed a balance on hand of $90.80.

The following officers were elected for the coming year:—

President .... A. F. Winn.
Vice-President .... G. Chagnon.
Secretary-Treasurer ...... Geo. A. Moore.
Librarian .... G. Chagnon.
Council .... G. A. Southee, Dr. Corcoran, J. G. Holmes, G. H. Hall.

Respectfully submitted,

Geo. A. Moore, *Secretary.*

REPORT OF THE TORONTO BRANCH.

The 210th meeting and 21st annual meeting of the Toronto Branch was held in the Biological Building of the University on Thursday, Oct. 18th, 1917, the President, Dr. Walker, in the chair. Those present were Dr. Walker, Dr. Cosens, Dr. Clemens, Miss Mossop, Miss Margery Ford, Miss Norma Ford, Messrs. Andrews, Logier, Hannibal, Brobst, Wright and Reid, and three visitors. After the reading of the minutes the report of the Council and the financial statement were presented by the Secretary-treasurer. Only seven meetings, including the annual meeting, were held during the year, with an average attendance of ten. This small number of meetings was due to the necessity of closing the season with the meeting of April 19th, owing to the fact that a number of the members were absent from the city early in the year. Four new members were elected during the year. The financial statement showed a balance on hand of $7.09.

The papers read during the season were as follows:—

Oct.	26.	Migratory Tendencies of Dragon-flies	E. M. Walker.
Nov.	23.	Life History of Ips pini	W. A. Clemens.
Jan.	18.	Pond Life	C. W. Nash.
Feb.	15.	City and Field Collecting	H. V. Andrews.
Mar.	15.	Ants and Aphids	S. Logier.
Apr.	19.	Mites and Ticks, and their Relation to Disease	E. M. Walker.

The election of officers for the ensuing year resulted as follows:—

President	Dr. W. A. Clemens.
Vice-President	Mr. H. V. Andrews.
Secretary-Treasurer	Mr. S. Logier.
Librarian	Miss B. K. E. Mossop.
Council	Dr. A. Cosens, Dr. E. M. Walker, Messrs. C. W. Nash, J. Hannibal and T. B. Kurata.

Two new members were also elected at this meeting.

The remainder of the evening was devoted to an informal discussion of various entomological subjects, in which most of those present took part.

Interesting observations were made by several members on the migrations of the Monarch butterfly (*Anosia plexippus*) and the Cabbage butterfly (*Pieris rapæ*) during the season of 1917 and many specimens of interest were exhibited and discussed.

Respectfully submitted,

Shelley Logier, *Sec.-Treas.*

REPORT OF THE BRITISH COLUMBIA BRANCH.

The Sixteenth Annual Meeting of the British Columbia Branch was held in the Provincial Museum, Parliament Buildings, Victoria, B.C., on Saturday, March 17th, 1917. The President, Mr. E. H. Blackmore, occupied the chair. There was a good attendance of members from various parts of the Province and much interest was taken in the papers presented.

The reports of the Secretary, Mr. R. C. Treherne and of the Treasurer, Mr. Williams Hugh, showed the Society to be in a very healthy condition and

were unanimously adopted. The meeting was divided into two sessions. During the morning session, Mr. E. H. Blackmore delivered his presidential address and the following papers were read:—

A Few Notes from Vernon	M. H. Ruhman.
(*a*) Hibernation of Larvæ; (*b*) The Movement of Boreus in the Snow	J. W. Cockle.
Collecting in the Okanagan District	W. Downes.
On the Hibernation of Lady-bird Beetles (Coccinellidæ)	T. Wilson.
Insect Notes of the Year	R. C. Treherne.

Afternoon Session.

Notes on Geometridæ new to British Columbia	E. H. Blackmore.
Pronunciation of the Scientific Names of Insects	G. O. Day, F.E.S.
Fossil Insects	Dr. S. Hadwen; Dr. A. E. Cameron.
Notes on B.C. Diptera	R. S. Sherman.
Factors in Mosquito Control	Dr. A. E. Cameron; Dr. S. Hadwen.

The Victoria sub-branch held meetings in the rooms of the Victoria Natural History Society in January, February, March and April, with an average attendance of nine members. The following papers were presented, illustrated with specimens of the subjects taken up:—

The *Parnassidæ* and *Papilionidæ* of British Columbia	E. H. Blackmore.
Leptarctia californiæ and Its Varieties	E. H. Blackmore.
The Lepidoptera of the Northern Okanagan	W. Downes.
The Species of the Genus Xylomyges Occurring in B.C.	E. H. Blackmore.

The past year has drawn heavily on our list of members; many of them answered the call to arms in the service of the Empire. We regret to record the deaths of two of our oldest and most valued members, Mr. A. H. Bush, of Vancouver, who was killed in action in France during August, 1916, and Mr. Tom Wilson, of Vancouver, who perished in a hotel fire at Hope, B.C., on March 6th, 1917.

The following officers were elected for the year 1917:—

President	E. H. Blackmore, P.O. Box 221, Victoria, B.C.
Vice-President	R. S. Sherman, Vancouver, B.C. (Coast).
Vice-President	L. E. Taylor, Okanagan, B.C. (Interior).
Secretary-Treasurer	Williams Hugh, P.O. Box 20, Cloverdale, B.C.
Advisory Board	Dr. A. E. Cameron, M.A.; G. O. Day, F.E.S.; Dr. S. Hadwen, and R. C. Treherne, B.S.A.

Respectfully submitted,

Williams Hugh, *Sec.-Treas.*

REPORT OF THE NOVA SCOTIA BRANCH.

The Third Annual meeting of the Entomological Society of Nova Scotia was held at Truro, Aug. 2nd, 1917. A short business meeting was held in the morning, this being followed by the reading of papers at the afternoon and evening sessions. There was an average attendance of about seventy-five at the meetings and the papers were listened to with interest.

The following officers were elected for the year 1917-1918:—

Honorary President .... DR. A. H. MCKAY, Halifax.
President .... L. A. DEWOLFE, Truro.
Vice-President .... G. E. SANDERS, Annapolis.
Secretary-Treasurer .... W. H. BRITTAIN, Truro.
Assistant Secretary-Treasurer... E. C. ALLEN, Truro.

W. H. BRITTAIN, *Sec.-Treas.*

REPORT OF THE ENTOMOLOGICAL SOCIETY OF ONTARIO TO THE ROYAL SOCIETY OF CANADA, 1916-1917.

FRANCIS J. A. MORRIS, PETERBOROUGH.

I have the honour to present a report of the Entomological Society of Ontario for the year 1916-1917.

The monthly issues of the "Canadian Entomologist" maintain the high standard and the wide range of interest that were noted last year. Well-illustrated, descriptive articles of great importance to specialists in various orders of insects have appeared in every number; several most interesting contributions to insect life-histories have also been made, as well as observations on insect distribution: among these we would mention papers by Dr. Walker, the editor, on the Dragonflies of Ontario, Prince Edward Island, and Newfoundland; an article on "Lake Shore Insect Drift," by James G. Needham, of Cornell, and one on "Beetles of the West Coast of Florida," by W. S. Blatchley, of Indianapolis.

The monthly series of articles on "Popular and Practical Entomology" has proved a great success and several papers of exceptional interest have appeared during the year, notably, "From the Editor's Office Chair," by Prof. R. P. Dow, of the Brooklyn Entomological Society; "Collecting Notes on Beetles in Maine," by C. A. Frost, of Framingham, Mass.; "The Control of Ants," by Arthur Gibson, of Ottawa; "The Plum Curculio," by Lawson Caesar, of Guelph; and, "Notes on the Black Apple Leaf-hopper," by Messrs. Brittain and Saunders, Entomological Division of the Department of Agriculture, Nova Scotia.

We are very glad to be able to call attention, too, to some steps taken in a much needed direction: I mean towards the co-ordination of all entomological interests in the Dominion. For the first recent steps towards this end credit is due, we believe, to our President, Mr. Winn, of Westmount, P.Q. More than a year ago he suggested that members with available duplicates among their specimens should make contributions to the public collections in Montreal and Guelph: this admirable suggestion has now been taken up at headquarters, and we note in the December issue of the magazine a call from Dr. Gordon Hewitt to all members of the Society to join hands in building up the National Collection of Insects at Ottawa. Again, at the last annual meeting, the President suggested that accounts should be published from time to time of all the more important entomological collections in the Dominion, both private and public. In earnest of this, Dr. Bethune, we note with extreme pleasure, has written an article on the Guelph collections, which appeared in the current issue of May, 1917.

Through lack of just such Dominion-wide co-operation, lovers of nature and students of our *flora* and *fauna* have been sadly handicapped in the past. Strangely enough botany is even worse off than entomology in this respect, for not only is the central government of the science defective, but there is neither a Linnæan Society

nor a botanical magazine of more than Provincial or merely local importance in Canada, and the work done by champions like good old John Macoun and the late James Fletcher has not been continued in recent years nor brought up to date for a quarter of a century.

Some exceptionally interesting publications, appearing during the year, have been reviewed in the pages of the magazine: e.g., Vol. IV of the "Biologia Centrali-Americana," by Lord Walsingham, which will be eagerly hailed by micro-lepidopterists all the world over; Blatchley and Leng's work on the "Rhynchophora of N. E. America," a long felt *desideratum* among students of the beetles and a worthy companion to the senior author's "Coleoptera of Indiana"; the "Life of Inland Waters," by Needham and Lloyd, the Cornell Professors; Dr. Van Duzee's "Check-list of the Hemiptera of America, North of Mexico"; J. M. Aldrich's "Sarcophagidæ of North America," being the first Memoir of the Thomas Say Foundation of the Entomological Society of America; and some of the articles in a supplement to the 47th annual report of the Department of Marine and Fisheries, Ottawa, 1915, called "Contributions to Canadian Biology," and comprising Dr. Walker's "Odonata of Go-Home Bay," and W. A. Clemens's "Ephemeridæ of the Georgian Bay."

Since your meeting of last May we have recorded with deep regret the loss of several old friends as well as of one of the founders of our Society. In June appeared the notice of Theodore Pergande's death, which occurred in March, 1916; first appointed an assistant in Missouri to C. V. Riley, he was afterwards associated for nearly forty years with the Washington Bureau of Entomology, and not infrequently contributed articles to our magazine. In the same issue was noticed the death (also occurring in March) of Geoffrey Meade-Waldo, of the British Museum of Natural History. He represented that Institution at the Society's Jubilee meeting in Guelph, August, 1913, and all who were fortunate enough to make his acquaintance remember the charm of his personality; his death at the early age of thirty-two means a great loss to British Entomology. A few days after the Royal Society's meeting last May occurred the death of John Bickerton Williams, of Toronto, F.Z.S., an old and faithful member of our Association, a true lover of nature and a man of most modest and gentle disposition. Finally, on November the 18th last, at Victoria, B.C., there passed away Edmund Baynes Reed, in the seventy-ninth year of his age. He was one of Ontario's pioneer entomologists, and a member of the original group who founded our Society more than fifty-three years ago. The very feeling tribute to his memory that appeared last February was from the pen of his life-long friend, our revered emeritus editor, Dr. Bethune, who now remains almost sole survivor of that little band of devotees.

The Society's annual activities culminated very fittingly last November in a grand two-day re-union at Guelph. The popular lecture was delivered by Dr. L. O. Howard, Chief of the Bureau of Entomology, Washington, on the subject of "Insects as Disease-carriers." Reports were presented at this meeting from six different districts of Ontario, as well as from the branches in Toronto, Ottawa, Montreal, Quebec, Manitoba, British Columbia and Nova Scotia. Visitors were present from the length and breadth of the Dominion, and also from several of the United States. Nearly a score of papers were read at the meeting, and the comments and discussions evoked by most of these, particularly by those of an economic character, bore eloquent testimony to the interest with which the proceedings were followed throughout. Practically a verbatim account of this meeting, including all the papers read, is now in the press and will shortly appear as the Forty-seventh Annual Report of the Entomological Society of Ontario.

ADDRESS.

J. C. Chapais, Delegate of the Quebec Society for the Protection of Plants.

Representing here, as a delegate, the Quebec Society for the Protection of Plants, I have thought it might interest you for a moment to hear about a note I found while perusing, recently, a French work on agriculture called "Le Livre de la Ferme," (The Book of the Farm), written by Pierre Joigneaux, an agronomist of France who has edited it at Paris since 1857. This book is considered as one of the classics on agriculture and as an authority in that branch of human knowledge, along with those of De Serres, De Domballes, Gayot, Gasparin, Barral, Isidore Pierre, Heuzé, etc. The note, to which I have just alluded, relates to an essay by a French-Canadian entomologist, Mr. Emilien Dupont who, in 1856, entered it in a competition opened to the entomologists of Canada, as appears from the following quotation:

Bureau of Agriculture and Statistics,
Toronto, 15th August, 1856.

On the 15th August, 1856, there issued from this department the following notice:—

Bureau of Agriculture and Statistics,
Toronto, 15th August, 1856

Prize Essays—£40, £25, and £15.

The above premiums will be paid for the three best essays, respectively, on the "Origin, Nature, and Habits—and the history of the progress, from time to time—and the cause of the progress, of the weevil, Hessian fly, midge, and such other insects as have made ravages on the wheat crop in Canada; and on such diseases as the wheat crops have been subjected to, and on the best means of evading or guarding against them."

The Essay to be furnished to the Bureau....................

P. M. Vankoughnet,
Minister of Agriculture, etc.

The time named in the notice first issued having been extended to the 15th day of April, twenty-two essays were received up to that time. The Boards of Agriculture for Upper and Lower Canada named Professor Hincks, of University College, Toronto, and Professor Dawson, of McGill College, Montreal, as a Committee, to decide upon the merits of the several essays.

According to the decision of these gentlemen, the *first prize* has been awarded to H. W. Hind, Esq., Professor of Chemistry, at Trinity College, Toronto; the *second prize* to the Rev. George Hill, Rector of Markham; and the *third prize* to Emilien Dupont, Esq., of St. Joachim.

Joigneaux, in his "Book of the Farm," fourth edition, edited in 1883, appreciates the prize-awarded essay of Dupont as follows, in chapter LI dealing with "Insects Injurious to Cereals," paragraph Cecidomyiæ, page 955, and I have thought that this quotation made by a French agronomist *d'outre mer* of the work of an entomologist of America would prove of some interest to you as it has for me.

Here is the quotation from Mr. Joigneaux:

"Mr. E. Dupont, who has observed keenly the habits of these insects (the *Cecidomyia*), when they were doing a great deal of damage in Canada, in 1834 and during the following years, has made some important observations from which he has drawn valuable indications.

"'*Cecidomyia tritici*,' he says, 'is delicate and can barely do more than move farther than a few acres from its native spot, and, at that, only in calm weather. The fields that

have been sown in wheat and which have been attacked by the *Cecidomyiæ* the preceding year, are much more infested with it than recently cleared land. Moreover, an observer has noticed prodigious numbers of *Cecidomyiæ* on potato vines planted in a field which had yielded wheat the preceding summer; these flies were henceforward harmless. Thus the necessity of alternating the crops and keeping wheat as long as possible from the lately infested spots is clearly indicated.

"'It has also been demonstrated through observation,' says Mr. Dupont, 'that by modifying the time of earing of the wheat so as to have it before the 16th of June or after the 20th of July, that is, before or after the time of appearance of the *Cecidomyiæ*, the damages caused by that insect are avoided.'

"Let us then, with Mr. Dupont, say to the farmers: If you dread the wheat fly for next year, do not sow your grain on the same field, nor in its neighbourhood; then, sow, if possible, in April; if this is too early, then wait till the first days of June; lastly, keep your fields clear from weeds which may offer secure shelter for the flies."

That quotation far off echo of what has been done, at a pretty far distant epoch, in Canada, by one of our entomologists, goes to show the spirit of co-operation in the study of the captivating science of entomology which leads the entomologists all over the world, though strangers they may be to one another, to work jointly for the elucidation of the numerous problems offered by that science.*

*The above mentioned essay of Emilien Dupont has been published in French in book form, as a pamphlet of 38 pages, of which the title page reads as follows: Essai sur les insectes et les maladies qui affectent le blé, par Emilien Dupont, Ecr., de St. Joachim, comté de Montmorency. L'auteur a reçu le troisième prix du Bureau d'Agriculture et des Statistiques. Montréal, des presses à vapeur du Canada Directory, rue St-Nicolas, 1857.

The name of Emilien Dupont is a pseudonym. The true name of the author is L'Abbé Léon Provancher, of the Diocese of Quebec, the well-known French-Canadian naturalist, who has written many works on natural history from 1857 to 1891.

REPORT ON INSECTS FOR THE YEAR.

Division No. 1, Ottawa District—Arthur Gibson, Entomological Branch, Ottawa.

Attacking Field Crops.

The Striped Cucumber Beetle, *Diabrotica vittata* Fab. In the early part of the summer a good deal of injury was caused by this insect, particularly to cucumbers and Hubbard's squash. Many plants of the latter examined on June 21st were seen to be seriously eaten. Experiments in controlling the beetle by spraying with ordinary poisoned Bordeaux mixture were successful, the plants being thoroughly drenched with the mixture.

The Ash-gray Blister Beetle, *Macrobasis unicolor* Kby., was again complained of in the district as injuring potatoes in the first half of July. On July 7th from one hill 150 beetles were removed.

The Imported Onion Maggot, *Hylemyia antiqua* Mg. In 1917 we continued our experiments with a poisoned bait spray (sodium arsenite), to attract and kill the flies, and as our results were of considerable value a separate statement on this work appears on page 31.

The Cabbage Root Maggot, *Phorbia brassicæ* Bouché. While not specially numerous, a good deal of injury was effected by the maggots. Complaints were received chiefly from amateur gardeners who found that their cabbage, cauliflower and turnip plants were being destroyed. One gardener brought to me, on July

9th, samples of young, badly-infested turnips, and stated that a patch about twenty feet square had been ruined.

The Colorado Potato Beetle, *Leptinotarsa decemlineata* Say, was responsible for enquiries from many city dwellers who were growing potatoes on vacant lots or other areas for the first time. The insect was present in large numbers throughout the district.

The Potato Aphis, *Macrosiphum solanifolii* Ashm. was also numerous during 1917, large colonies of the plant lice being present in gardens and fields in Eastern Canada. At Ottawa the insect was controlled satisfactorily by spraying with black leaf 40.

The Potato Flea Beetle, *Epitrix cucumeris* Harr. Potatoes were freely infested with this insect, its injuries attracting particular attention during early July. Tomatoes and, to a much lesser extent, cucumbers, were also attacked.

The Zebra Caterpillar, *Ceramica picta* Harr. In September this caterpillar was present in considerable numbers in various sizes from about one-quarter inch in length to almost full grown individuals. The leaves of turnips and cabbages were freely eaten.

The Woolly-bear Caterpillars, namely the Yellow Woolly-bear, *Diacrisia virginica* Fab. and the Salt Marsh Caterpillar, *Estigmene acraa* Dru were exceptionally abundant in Eastern Canada in 1917. In the Ottawa district, in August and September, the foliage of low-growing plants of many kinds was much injured. In vegetable gardens cabbages, turnips and other plants were eaten. It is many years since we had such an outbreak of these hairy caterpillars.

Wireworms (*Elateridæ*) and White Grubs, (*Lachnosterna* spp.). Some injury was caused by the former, the complaints referring chiefly to damage to the tubers of potatoes. The worms bored into the tubers and rendered them unfit for use. Practically no injury was caused by White Grubs in the district. There were important flights of *Lachnosterna dubia* during the latter half of May and we may expect injury by the second year grubs in 1918.

Grasshoppers. An outbreak of the Slender Meadow Grasshopper, *Conocephalus fasciatus* DeG., caused noticeable injury to field corn near Norway Bay, Que. The insects were present in large numbers and many hills in several rows had been almost completely eaten. The insects were particularly attracted to the male flowers and the nearby tender leaves. The injured rows were largely in a low lying portion of the field.

Slugs. These creatures were decidedly destructive to many kinds of vegetable crops. The leaves of lettuce, beans, carrots, tomatoes, corn, etc., were freely eaten. In some fields of beans the slugs were present in large numbers and were causing considerable loss. As a remedy we recommended the broadcasting, lightly over the soil before nightfall, of freshly slaked lime. Three applications on consecutive evenings were advised. Reports received afterwards indicated that such control was effective. In gardens the placing of shingles here and there beneath low growing plants is a useful method of trapping slugs. If the shingles are turned over in the morning the slugs there hiding may be easily destroyed by scraping them off and crushing them with the foot.

The Carrot Rust-fly, *Psila rosæ* Fab. In a few gardens in the Ottawa district the work of this insect was readily apparent. Such infestations as we heard of, when investigated, were found to be too far advanced to make possible any control measures.

The Horse Radish Flea-beetle, *Phyllotreta armoraciæ*. Although rather outside of the Ottawa district it is of interest to record here the occurrence of this

beetle in considerable numbers at Outremont, Que. One of our correspondents (Rev. Bro. Ouellette), sent to us leaves of horse radish which had been riddled by the beetles. When first discovered no less than 150 specimens were captured by shaking some leaves over a beating net.

Attacking Fruit and Forest Trees.

The Red-humped Apple-tree Caterpillar, *Schizura concinna* A. & S., was more than usually abundant in some orchards in 1917.

The Cherry Slug, *Eriocampoides limacina* Retz., was also present in noticeable numbers.

The Eye-spotted Bud-moth, *Tmetocera ocellana* Schiff., caused important injury in certain unsprayed orchards.

The Halisidota Tussock Caterpillars, namely, the Hickory Halisidota, *H. caryæ* Harr., the Spotted Halisidota, *H. maculata* Harr., and the Checkered Halisidota, *H. tessellaris* A. & S., were remarkably abundant throughout the Ottawa district. The previous outbreak of these caterpillars was in 1907. During the past season they occurred on apple, elm, basswood, maple, birch, and other trees. Conspicuous injury to the foliage of apple by the Hickory Halisidota was observed on August 8th. During the latter half of August and the first half of September the three different Halisidotas were conspicuous almost everywhere in the neighborhood. Around summer cottages they were a decided nuisance from their habit of dropping on people, crawling about verandahs, etc.

Garden and Greenhouse Insects.

In flower gardens, in addition to cutworms, which were more or less in evidence, the Four-lined Leaf Bug, *Pœcilocapsus lineatus* Fab., rendered unsightly the foliage of asters, dahlias, zinnias, etc. The Burdock Borer, *Papaipema cataphracta* Grt., was present in more than usual numbers and destroyed many choice delphinium, dahlia and other plants with succulent stems. The Bordered Sallow, *Pyrrhia umbra* Hufn., was again noticed to be destroying the buds of roses at Ottawa. On July 21st young larvæ about one-quarter inch in length were found.

The above species of woolly-bear caterpillars (*Diacrisia virginica* Fab. and *Estigmene acræa* Dru.) were very numerous in flower gardens. Both of these caterpillars are, in general, of similar appearance and habits and feed on a great variety of plants.

There were no special outbreaks of greenhouse insects during the year. Regularly-occurring species such as the various common aphids, scale insects, etc., required constant attention. In the control of soft scales on ferns we have had satisfactory results by spraying rather heavily with three ounces of Sunlight soap to each gallon of water. Several applications, a week apart, were necessary.

Division No. 3, Toronto District—A. Cosens.

Although the average temperature in this district, during July and August, was lower than usual, yet the climatic conditions, in some way not easily explained, have proven favorable to the production of certain forms of insect life as several species were exceedingly abundant.

Especially is this true concerning the Lepidoptera; it has certainly been an ideal season for the development of caterpillars.

The White-marked Tussock Moth, *Hemerocampa leucostigma* S. & A., has not been so plentiful for several years; it took complete possession of the city. In some of the down-town districts the shade trees, especially the horse chestnuts, were almost completely defoliated. In certain parts of the suburbs the caterpillars were numerous, where in former seasons only isolated wanderers were to be seen. In Parkdale, practically all the streets were invaded by them and they even found their way into the houses.

"They were the terror of each favorite walk,
The endless theme of all the village talk."

On the elms of the city the caterpillars of *Acronycta americana* were plentiful enough to do considerable damage. This common species is easily identified by its dense covering of yellow hairs and the long, black pencils of bristles regularly placed on the body.

As a general rule, the "woolly bear" caterpillar, larva of the Tiger Moth, *Diacrisia virginica* Fab., is noticed only in the fall, when it is hurrying about in an eager quest for food before going into winter quarters. This year, however, these reddish-brown larvæ were plentiful in many gardens throughout the entire summer. While they seemed to prefer Virginia creeper they were often seen feeding indiscriminately on grape vines, honeysuckles, lettuce and other plants.

The Isabella Tiger Moth, *Isia isabella* S. & A., the larva of which differs from the preceeding in being black at each end, was seen only in normal numbers although it is generally the more abundant species of the two.

The White Cabbage Butterfly, *Pontia rapæ* Linn., has been a much worse pest than usual this summer. Although cabbage patches were plentiful owing to the general cultivation of vacant land, yet every plant observed seemed always to be an object of interest to a swarm of butterflies.

In connection with the surprisingly large number of these butterflies seen in this district during August, the following note, kindly written at my request by Mr. Andrews of the city, is very interesting:

"Apparent Migration of P. rapæ (Cabbage Butterfly).

"On Sunday morning (about 11.30), Aug. 12th, my attention was attracted by a number of these butterflies coming inland off Lake Ontario.

"Sitting down to watch where they came from, one can imagine my surprise at seeing a huge swarm of these insects flying low over the Lake towards Kew Beach—there were positively thousands of them.

"For three or four days after their arrival they were a perfect pest to people sitting or walking on the beach—they were everywhere and flying with them were the largest number of dragonflies I have ever seen.

"I don't hesitate to add that this swarm of *P. rapæ* came over the Lake, as everything regarding the weather was in their favour. The wind at the time of their arrival was gentle and blew south-south-west, and they seemed to be flying with it."

Although the Monarch Butterfly, *Anosia plexippus* Linn., was very numerous last year, it has been even more plentiful this season. During August ample evidence was furnished concerning the congregating habits of these insects. Flocks of them were seen in High Park, Mimico, and other places, even including the

verandahs and shade trees of a street in South Parkdale, where a small swarm collected.

At the same time as the butterflies were gathering together, the Bronzed Grackles were congregating. While among the insects there is of course none of the friendly clamor with which the members of a flock of blackbirds greet each other, yet it would seem that the butterflies are influenced by the same liking for companionship as the birds.

Concerning the starting off of a swarm of butterflies on their long journey to the south, Mr. Andrews, quoted above, has made an important observation. It is only by the collecting of such material that we shall ever be able to unravel the mystery of the migrating tours of this typically American insect the Monarch Butterfly.

"On Sunday afternoon, Sept. 2nd, between 4 and 5 o'clock, I witnessed the departure of a huge swarm of *Anosia plexippus*. The swarm had been congregating for days in Kew Gardens; they flew from the centre of the Gardens towards the Lake and settled on the trees about 100 yards from the Lake. Here they stayed but a few minutes, rising as it were at a given signal they flew off over the Lake in a dense cloud. One thing which I particularly noticed was that their flight was rapid, as if they intended reaching the U.S.A. or wherever they were going in as short a time as possible.

"I forgot to notice the direction of the wind."

A number of Scarlet Oaks, *Quercus coccinea* Muench. in West Toronto, were badly infested with a species of Bucculatrix. Several branches from these trees were examined, and it was found that on nearly every leaf there were two or three of the flat, silken webs, under which the larvæ feed after their first moult.

Among other lepidoptera noted as more than usually plentiful, were the House Moth, *Tinea pellionella*, Linn., and two of the large silkworm moths, *Samia cecropia* and *Telea polyphemus*.

Division No. 5, Peterborough District—F. J. A. Morris, Peterborough.

In spite of an extremely backward season and almost uniformly cool summer, the record of captures is one of the best I have ever had. This is true in regard both to single specimens of great rarity and interest, and to long series of insects either new to me or very poorly represented in my collection. By far the most of my observations have been among the Longicorns, and a great many of them have been obtained by following the clues of last season. My report is, therefore, in many respects a sequel to that of last year and is more nearly related to its forerunner than has usually been the case.

In 1916 I had discovered feeding on choke-cherry foliage a single specimen of a chrysomelian that was new to me. I thought at first it was a species of *Lina* (the change of colour on the thoracic border being mistaken for a thickened margin), but it proved to be *Gonioctena pallida*. The capture had been made about the middle of June. This season I took three specimens in the last week of May, fifteen in the first week of June and a few some days later. They were all found in the same corner of the collecting ground known as "The Wood of Desire"; nearly all on the foliage of choke-cherry, but two on pincherry and one on balm of gilead. Careful search on similar foliage in many other places has so far been without result; I do not know how common or how widely distributed the insect is. In size, shape, and colour it closely resembles *Lina interrupta*; the black

marks on the bright reddish-brown elytra vary considerably in weight and are occasionally almost entirely wanting.

Last year's report mentioned basswood as the probable host of some stray specimens of *Chrysomela* captured by the roadside; these were a robust form of *Chrysomela scalaris,* both larger and more strongly marked than the variety found here on alder; another was captured this season at the same spot—west of Jackson's Park—and careful search along the road margins and fences finally disclosed the breeding ground—two basswoods about 100 yards north of the road: here large numbers of the insect were found and upwards of fifty specimens captured about the middle of June.

The usual insect activity about blossoms in June and July was far below the normal, owing to lack of bright, calm days of summer heat. For instance, before Victoria Day in 1916 numbers of *Pachyta monticola* were captured in white trillium, early elder, and other blossom. This year hardly a longicorn of any kind was to be seen in May, and the trilliums were almost over before we had made a single capture. Much of the blossom itself was nearly ten days late: in 1916 choke-cherry had been almost over between June 4th and June 10th: this year it did not open till the latter date. However, during the short season of its bloom I was most fortunate in getting about three good days' collecting round the "Wood of Desire," and the results were well worth recording.

The puzzling little *Anaglyptus*—*Microclytus* or *Cyrtophorus*—of which we got some fifteen specimens in 1916 and noted two pairs mating, was observed in considerable numbers on June 9th, 11th and 12th, always on choke-cherry: and as late as June 24th four specimens were taken on dogwood blossom (*Cornus alternifolia*) and spiked maple, the choke-cherry being by that date over. A pair was once more seen mating in a flower cluster, and this time was segregated and marked male and female as a verified pair. Altogether over 100 specimens were captured at four different parts of the wood, always just on the edges. On June 12th, a very warm day and bright, over seventy specimens were captured, more than a score being taken from a single tree. Except for its smaller size, the slighter gibbosity of its elytral bases and the less marked compression of its thorax, the beetle can hardly be distinguished in the open from *Cyrtophorus verrucosus*; but it is much more sluggish in habit and crouches or clings in the blossom when approached in a manner quite foreign to *Cyrtophorus*. One of the most interesting points of this year's observations was that about fifty of the insects were brought home alive in small pill boxes, and when released from isolation and put together in a large glass-lidded cardboard box began to mate freely; indeed, within a few minutes I was able to withdraw nearly all the insects in verified pairs. The beetle has several important points of identity with *Cyrtophorus* and at least one essential difference from *Microclytus gazellula*. It can hardly fail to prove extremely close to the European *Anaglyptus mysticus*; it is almost certainly the insect named from Lake Superior by Dr. LeConte as *Microclytus gibbulus*: it is the same as Casey's *Microclytus frosti*, and will be found in many collections, public as well as private, labelled *Microclytus gazellula*.

While ransacking blossom for this little *Anaglyptus*, several longicorns new to me or rare, were taken in June. On the 9th a beetle was distinctly seen to fly from a grove of beechtrees to a cedar near the wood: it proved on capture to be *Anthophilax attenuatus*, an insect entirely new to me. Mr. Harrington has reported it from beech in the Ottawa district. On June 11th, resting on the top foliage of a tall choke-cherry, a beautiful specimen of *Anthophilax malachiticus* was taken, the second insect of this species captured by me in over twelve years'

collecting. A curious observation was made on this date, June 11th; it was a dull day and the wind was chilly; I captured only eleven specimens of *M. gibbulus,* and these were all taken alive; but it proved impossible to secure a mating pair; on measuring the antennæ, I found them all short—three-quarters the body length: they were all females, and I infer that in cool weather the males are less active and do not visit their favorite pollen blossoms; both before and after that date, on bright, hot days, the males were almost as plentiful as the females.

Professional duties combined with a wet week end to interrupt field observations between June 12th and 23rd. On the latter date I captured the first of a series of the longicorn *Psenocerus supernotatus*; I had previously captured but one or two isolated specimens at long intervals; this season I captured one on willow, three on sumach, and four or five on newly fallen balm of gilead; these last were all of a very small variety, the others of normal habit. The specimen captured on the 23rd was found resting on a thick limb of willow that was dying from the attacks of *Cryptorhyncus lapathi.* On this date while examining the trunk of a large felled spruce that had been cut into three logs and stripped of its branches I saw what at first I took to be an elater crawling on the bark; its movements and the appearance of its antennæ, however, being suggestive of *Asemum,* it suddenly occurred to me that it was on spruce I had once captured *Tetropium cinnamopterum.* This insect is usually parti-coloured, the head and thorax piceous and the wing-covers light cinnamon brown, whereas the creature before me was all piceous, and both smaller and narrower than any of *Tetropium cinnamopterum* I had ever seen. It proved, however, to be that species. For some time I could see only this one specimen, but just as I was going away I caught sight of a second, small and unicolorous like the first, just disappearing over the far side of the log. I raced round the log to intercept it, but when I got there to my amazement there was no insect, either on the log or on the ground. Now the bark of a spruce is rough and flaky; more or less idly I began lifting the flakes with a jack-knife, when suddenly from under one of them raced into view one of the parti-coloured forms of *T. cinnamopterum*, followed by its mate, the small piceous insect I had been looking for. Acting on this hint I continued to prise up the flakes of bark and succeeded in flushing seven or eight of the insects, of which I captured five; once a pair in conjunction, both sexes being of the small, piceous form. It was really astonishing that pairs of this insect should lie so close under the comparatively small, tight-fitting flakes of bark, but on reflection I had to acknowledge that I had captured once over a score of the robust *Physocnemum brevilineum* pairing just as snugly in the interstices of elm bark. Newly felled spruce, then, in the latter part of June is evidently a breeding ground for this uncommon longicorn *T. cinnamopterum.*

I paid several visits to the spruce, but it was only on the 23rd and 24th of June that I found this beetle. My perseverance was, however, amply rewarded: on July 6th I captured near the axil of a broken branch a specimen of *Merium proteus*: it is hardly safe to generalize from a unique capture, but the date and habitat of felled spruce trunk are perhaps worth noting by Canadian collectors. The descriptions which refer to this insect as yellow-brown have evidently been taken from cabinet specimens; in the live insect, head and thorax are rich violet, and the elytra appear as though dipped in violet dye, the tinge of which may be caught anywhere on their surface if held in the proper light: the elytra being thinner and translucent, appear less dark in hue than the thorax whose density renders it quite opaque. The thighs are bright yellow, almost the shade of the root fibre of Goldthread (*Coptis trifolia*) and very conspicuous. This matter of coloration in published descriptions is very misleading. For instance, *Encyclops*

cæruleus is spoken of as "blue" or "bluish." I have captured forty or fifty specimens of this beetle, and I never saw one that was not of a beautiful light-green shade with a texture as of silk. If, however, a specimen remains too long in the cyanide bottle, it will turn to a dull bluish colour, losing all the lustre of its surface. Again, *Anthophilax malachiticus* is really a rich and glittering green; it has a metallic lustre which reflects yellow and copper at certain angles, but I can find no trace of the "blue shade" of printed descriptions.

On June 24th a trip to the west edge of the "Wood of Desire" yielded me two specimens of *Leptura pedalis*; a unique specimen captured on the same shrub (a large bush of alternate-leaved dogwood) in 1916 had been my one and only hint of the insect's presence in the neighborhood; it was on this date and on this shrub that I captured my last *Microclytus gibbulus* of the season.

Work and weather prevented further records till July 2nd. On that day during a motor trip west of Chemong I visited a steep hill crowned with basswoods, and while examining the foliage of one of the biggest of these I captured a specimen of *Hoplosia nubila*, which roused me to a vigorous search in the hope of more. Presently on a dead branch jutting from the lower trunk I captured a second; I then got over the fence into an open field so as to be on the sunny side of the tree; on the fence I captured three more specimens, and finally located a dead limb of basswood lying high and dry on a bank of field stone under the tree; here *Hoplosia* was evidently breeding and I had most fortunately come jump with the hour of emergence. I captured altogether some twenty-five specimens on this limb and on rails of the fence beside it. A few days later I took six more at the same place and also captured about ten in other places. In the limb I found several larvæ and an imago in the act of emerging. There seems no doubt that *Hoplosia nubila's* favorite food is dead basswood, and its tunnels are all near the surface, within or just below the inner bark. Several of my captures were made on newly felled basswood; it is probably here that ovipositing first takes place, and then, perhaps, the colony that emerges pairs and oviposits on the home-tree. An interesting observation was afforded by the capture of one specimen on a newly fallen maple; last season I took one on fresh fallen beech. Beech and basswood only are mentioned in Blatchley as hosts of *Hoplosia nubila*.

July 2nd was altogether a phenomenal day in my entomological year. Late in the afternoon on a "brush-head" of dead hemlock thrown on to a snake fence as top rail, I captured two strange weevils; they were several feet away from one another, both on the main stem; on minute examination they proved to be male and female; the male was 5 mm. long and its antennæ were about three-quarters the body length; the female was 6 mm. long and its antennæ only two-fifths the body. The insect was an anthribid, with a white snout, white scutellum, broad white patch near the elytra base, and a dainty little device in fawn-coloured pubescence on the thorax, shaped like a miniature fleur-de-lys or trefoil, otherwise the insect was almost uniformly black, not shining, but dull and rough; it proves to be *Gonotropis gibbosus*, an insect *sui generis* and of great rarity.

From the end of June I kept my eye open especially for *Lamiinids* of the *Acanthoderini* group. In 1916 I had secured quite a range of species on poplar, and an equally wide range had been reported to me as occurring on sumach; as the two ranges only partly coincide, I was anxious to get personal corroboration of both records this year.

I found *Hyperplatys* emerging as early as July 2nd from felled or dying poplar, and a few days later it became quite common, especially on balm of gilead. Two specimens, also, of what appears to be *Liopus variegatus* were captured on

fallen or felled trees of this species. I had taken thirteen specimens in 1916 on billets of poplar in a wood pile; there is no doubt that the insect breeds in the balsam poplar with us; a curious thing about my specimens is that they have distinct traces of ciliate fringe under the antennæ, especially on the third joints; many of them are as heavily fringed as *Hyperplatys*. I have specimens of *Liopus alpha* and *cinereus* captured in Ontario that are similarly adorned. Another peculiar feature is the colour; all my specimens of *L. variegatus* (var. *obscurus*?) are very dark grey, almost black. I strongly suspect that both ciliation and "melanism" are a question of latitude. For that reason I find the proportionate length of basal joint to the other joints in the hind tarsi a better test of generic character.

Examination of staghorn sumach during the first part of July resulted as follows: After July 5th many specimens of *Hyperplatys* were captured; a single specimen of *Goes oculata* was taken on a dead limb; a single specimen of *Leptostylus macula* on a bruised shoot; a specimen of *Toxotus schaumii* on the foliage; a specimen of *Lepturges signatus* and about twenty specimens of *Liopus alpha* on the stems.

On July 11th while looking over some newly lopped branches of basswood on the edge of a grain field I captured *Hoplosia nubila,* and a specimen of that dainty little insect with the flying hairs—*Eupogonius subarmatus*. This last I have never found in Ontario except on basswood; more than ten years ago I captured two in the Rideau district on basswood: three or four years ago I took more than a dozen on basswood in the Niagara Glen (towards the end of July), and a few days later two specimens near Peterborough. I have never seen basswood given in any book as the insect's host, but generally elm.

Just after the middle of July we went into our usual camp on Cache Lake, Algonquin Park. I was greatly disappointed not to find any more specimens of *Leptura plebeja* this season on the spiræa blossom; the weather was not favorable for sun-loving insects that frequent flowers, but in other respects the captures this year were exceptionally good. And even in the matter of *L. plebeja* I have, as it proves, been extremely fortunate this summer of 1917. Towards the end of July, during a succession of very hot days, I made on my boathouse window several interesting captures including *Leptura sex-maculata, L. subhamata, L. biforis* and a small black longicorn that I bottled for *Typocerus lugubris*. On removing this last from the jar of moist sawdust in September, I found it had the antennæ annulate with pale brown and devoid of poriferous spaces; it proved, in fact, to be a *Leptura*, and almost certainly the male of *L. plebeja*. When compared with the four other specimens (all apparently female) of this beetle in my cabinet, the insect has two features of special interest, viz.: (1) Its much smaller size, (2) its entirely black abdomen, there being, on the under side, no traces of the brown outer segments that characterize the female.

Two species of *Acmæops* were taken on white pine in the third week of July; a specimen of *Leptura sex-maculata* on July 18th; a specimen of *Leptura pedalis* and several of *L. chrysocoma* (on spiræa) in the fourth week of July; also an unidentified species of *Leptura* (on yarrow). During the last week of July and for three weeks of August *Leptura subhamata* was found abundant on spiræa and elsewhere. After Aug. 5th *Leptura canadensis* became common, both sexes being taken on spiræa blossom and on dead pine and balsam. I notice that these sun-loving *Lepturids* which frequent blossoms seem to prefer standing to fallen timber, and the upper side of branches, whereas the shade-loving *Lamiinids, Monohammi* and others that are not attracted to blossoms, crowd to fallen timber and the under side of the limbs. Among *Lepturas*, it was an agreeable surprise this year to

capture quite frequently specimens of the uncommon *Leptura biforis*; I took eight in the second and third weeks of August. A curious thing about the species is that it does not seem to share in the Leptura's generic love of pollen; it is the only species I have never seen on blossom; on the other hand I have more than once captured it settling on newly felled white pine, and nearly all my captures this season were made in front of the tent, the insect flying across the open in the immediate neighbourhood of a large white pine.

For a native of Perthshire, I celebrated the opening days of the grouse shooting season very appropriately: On August 12th I made the largest bag of the season and in some ways the most interesting, while on the 15th I included in my bag of ordinary game a prize as rare as the Capercailzie would be on a Scottish grouse moor—a beautiful specimen of *Monohammus marmorator* ♀; it was captured on a windfall (fresh this season) of balsam fir, while ovipositing on the upper side of the trunk, near a branch axil. It is only the third specimen I have seen in twelve years; my first was captured similarly on fallen balsam near the Village of Lanark, Ont., and the second near Port Hope; all three in my collection are females; the species is recorded as fairly common in the Lake Superior region.

For my last note of the season I shall revert to my captures of August 12th. It was an ideal day for collecting; very hot, bright, and perfectly calm. A party of six or eight of us had paddled up the Madawaska to White's Lake and were lunching on a slope by the shore. It is a favorite spot for picnics, which unfortunately explains how it came to be partly burned over a few years ago. Dead trunks of hemlock, balsam, spruce, pine and birch still stand up among the raspberries that have encroached on the scene of the fire; the rest of the point was saved by the fire rangers' heroic efforts, and it was at the edge of the burnt space, in a hemlock grove with a few scattered pine, spruce, and balsam, that we were lunching. Just after our meal, as my thoughts stole guiltily in the direction of my insect net, I saw something that sent my fingers clutching suddenly for the cyanide bottle: a log-runner (*Xylotrechus*) racing madly up a limb in the direction of the trunk: unfortunately the limb he had chosen to exercise on was the thigh of one of the least entomologically minded members of the party, or the longicorn might either have escaped or at any rate died gloriously without being mutilated. but before I could interfere a horny hand descended in a shower of blows on the "pesky yellow-jacket," and the next moment it lay on the ground "a trunk and a head torn from the shoulders," though not "a body without a name"—*Xylotrechus undulatus.* I was soon busy examining all the standing balsam on the edge of the grove, especially trees that showed signs of languishing and had their trunks in the sun, for it had always been on such trees that I had taken this insect: indeed, only a fortnight before I had captured five on the upright shaft of a dying balsam at Head Lake. Soon my search was rewarded by the capture of six specimens, at the same time I noticed large numbers of *Melanophila fulvoguttata* and two species of *Chrysobothris* settling on hemlock—living trees on the sunny edge of the grove. A close scrutiny of their trunks presently revealed a pair of *Xylotrechus undulatus* mating on the bark and two or three single specimens basking in the sunlight. Before we returned to our canoe I had captured (nearly all on hemlock) sixteen specimens of the longicorn and some thirty-five of the buprestids. On the same day I secured one specimen of *L. subhamata,* two *L. biforis,* and nine *L. canadensis.*

At no other time or place have I seen *X. undulatus* on hemlock, and I fancy the fire is responsible primarily for the prevalence of these woodborers: it has not only killed and wounded a great deal of timber, but has exposed a wide space to

the combined action of wind and sun: this has meant greatly increased ovipositing in a restricted area, and as part consequence of such "intensive culture," *Xylotrechus undulatus,* first bred in balsam, has then tackled the neighbouring and not very alien trunks of hemlock, much as the apple web-worm advances from orchard to forest trees in search of fodder as soon as its native pastures begin to fail.

Division No. 6, Essex District—J. W. Noble, Department of Agriculture, Essex, Ont.

Attacking Field Crops.

Wireworms, White Grubs, Cutworms. Considerable damage done to the strawberry beds and spring crops by white grubs; the damage from wireworms and cutworms, however, not so great as in an average year. Adults of all species quite common.

Attacking Fruit Trees.

Codling Moth. Very plentiful on apples and pears in uncared-for orchards, very little damage where spraying was practised. Considerable second brood.

Plum Curculio. Considerable damage to plums, to a less extent to apples.

San José Scale. Still quite plentiful in neglected orchards on hawthorns and some other shrubs, completely controlled in cared-for orchards.

Tent Caterpillars were not common, only a few nests observed during the season. Fall web-worms plentiful, some orchards averaging two webs to a tree.

Aphids. Quite common but more especially troublesome on small vegetables.

Peach Tree Borer. Has ruined a few orchards this year; seems to be plentiful and rather on the increase.

Attacking Small Fruits and Vegetables.

Melon Aphid and Cucumber Aphid. From these insects we suffered a great loss in Essex County this year. Cucumber aphids were responsible for 75 acres of cucumbers being plowed up. In fields where spraying with tobacco decoction was commenced in time no harm resulted. Some patches were sprayed as many as five times. Two cases came under my notice where the plants were dusted with tobacco flour, spraying being done by two men, one holding the vine while the other did the spraying and the plants were killed. Bees were restrained from visiting the blossoms and the patch had to be plowed up. Melon aphids also killed a large acreage but were controlled by some of the best growers of large plantations by the use of tobacco water, 1 lb. to one gallon.

Onion Root-Maggot. This insect did a large amount of damage in the onion marsh and experiments in this county did very little to control its ravages.

Onion Thrips. Again very common and harmful. No results from spraying this year.

Cabbage Root-Maggot. Very little damage by cabbage root-maggot owing to wet weather during the season the flies were laying eggs.

Asparagus Beetle. These seem to be becoming very common and have done considerable damage by making stems unmarketable.

Bean Root-maggot. Although considerable damage was done in other sections no reports of injury were received from this county.

Tobacco Worm. Very common: controlled in a great many instances by spraying with arsenate of lead, considerable number trapped by poisoned Jamestown weed.

GRAPEVINE FLEA-BEETLE. Common in what small acreages are grown.

CURRANT SAW-FLY. Very common on currants and gooseberries that were not sprayed with hellebore.

GREENHOUSE INSECTS.

Considerable damage was done to tomatoes by eelworms (*Nematodes*). This was effectively controlled in some cases where it has been bad in previous seasons by the removal of the soil to a depth of about 8 inches. The general greenhouse pests seem quite active this year including aphids and greenhouse white fly: cucumber beetles doing considerable harm. Hydrocyanic gas was used for the first time in a number of greenhouses for the control of white fly.

DIVISION NO. 7, NIAGARA DISTRICT—W. A. ROSS, DOMINION ENTOMOLOGICAL LABORATORY, VINELAND STATION, ONT.

In spring and early summer, the weather was abnormally wet. At Vineland the precipitation for April, May, June and July was 16.56 inches.

Early in the season, due to the unfavourable meteorological conditions, there was a paucity of insects: later on, however, they became quite abundant. An unusually large number of insect outbreaks were reported to me. Some of the outbreaks were real but many of them were imaginary.

INSECTS INJURIOUS TO FIELD CROPS.

THE WHEAT MIDGE (*Itonida tritici*). On July 18th, I was called upon to investigate what was supposed to be a serious outbreak of wheat midge in the Niagara Peninsula. I found the pest generally distributed throughout Welland and Lincoln counties and I understand that it was also present in other parts of the Peninsula. Here and there where the wheat was backward, the midge was abundant, but on the whole, the infestation was very light.

In three of the worst infested fields, I found by counting the plump and shrunken berries that about 35 per cent. of the grain was more or less shrivelled. In heads containing 1,357 kernels 1,001 maggots were found, the number of larvæ per infested kernel varying from 1 to 10.

In a rearing cage in which infested wheat heads had been placed, one adult midge emerged on August 10th.

THE GRAIN APHIS (*Macrosiphum granarium*). During the latter part of July the grain-aphis came into prominence. It was very abundant on oats in certain sections of this district and produced so much alarm among grain merchants that, according to a St. Catharines dealer, the price of oats jumped ten cents. I looked into this outbreak, and, as I expected, found that the reports of serious losses being caused by the insect were without foundation. Natural checks—hymenopterous parasites, ladybird beetles, syrphid larvæ, *Entomophora* etc., as usual prevented any serious injury.

THE OAT MIDGE. The grain-aphis was succeeded by the oat-midge which, according to report, was destroying all the oats in the neighbourhood of Port Robinson. This depredator proved to be oat stamens.

THRIPS ON CLOVER. The blood red larvæ of *Haplothrips statices* Hal. were decidedly abundant on the heads of alsike clover in the vicinity of Ridgeway, but, so far as I could make out, they did not cause any appreciable injury to the crop of seed.

My attention was directed to this insect because the farmers mistook it for the notorious clover-seed midge.

THE CLOVER SEED MIDGE (*Dasyneura leguminicola*). In August, I was asked by a Vineland farmer to look at a field of red clover which was blooming very irregularly. On examining some of the clover heads numerous pinkish larvæ of the clover seed midge were found within the flower tubes. According to an estimate I made, at least 44 per cent. of the florets were infested or in other words 44 per cent. of the seed crop was destroyed.

THE CLOVER SEED CATERPILLAR (*Laspeyresia interstinctana*). This species was common on alsike (Ridgeway, July 27th) and on red clover (Vineland, August).

THE SEED-CORN MAGGOT (*Pegomyia fusciceps*). This species was very destructive to beans in Welland County.

FRUIT PESTS.

As Prof. Caesar in his report on "Insects of the Year in Ontario" will deal fully with the fruit insects of the Niagara Peninsula, I shall confine my attention to three species.

THE WHITE-MARKED TUSSOCK MOTH (*Hemerocampa leucostigma*) was unusually abundant on orchard trees, and a considerable amount of injury was done to apples by the larvæ gnawing into the fruit.

N.B.—The calloused blemishes on apples to which I referred in my report for 1916, are undoubtedly the work of this insect.

THE PEAR PSYLLA (*Psylla pyricola*) was very abundant and injurious in certain parts of the district.

THE APPLE MAGGOT (*Rhagoletis pomonella*): As the apple maggot is rarely destructive in the Niagara district, it is worth while mentioning that this insect was decidedly injurious in a small apple orchard near Vineland.

MISCELLANEOUS INSECTS.

CHERMES. The Spruce Gall-louse *C. abietis*, which in the last few years has been comparatively scarce, was abundant this past season on Norway Spruce.

CHERMES PINICORTICIS was very conspicuous on young white pines near Stoney Creek.

WOOLLY-BEAR CATERPILLARS were remarkably common this fall. Complaints were received about them attacking raspberry bushes.

In a Hamilton greenhouse, the YELLOW WOOLLY-BEAR (*Diacrisia virginica*) attacked and skeletonized the foliage of Chrysanthemums.

FURTHER NOTES ON THE IMPORTED ONION MAGGOT (*HYLEMYIA ANTIQUA* Mg.) AND ITS CONTROL.

ARTHUR GIBSON, CHIEF ASSISTANT ENTOMOLOGIST, ENTOMOLOGICAL BRANCH, DEPARTMENT OF AGRICULTURE, OTTAWA.

In Entomological Bulletin No. 12 of the Dominion Department of Agriculture, the imported onion maggot is discussed on pages 29 to 32 and its control under field conditions on pp. 47 to 49. Since the publication of this bulletin in May, 1916, further observations on the overwintering habits of the

insect have been made and investigations directed towards controlling it under field conditions.

In the spring of 1916, a special search was made for the puparia in land near Ottawa which had been used for onions in 1915. On April 25th, one puparium was found in the soil at a depth of 4½ inches. On April 28th a further search was made with the following results:—

1	puparium	found	at a depth of	3	inches
1	"	"	"	3⅝	"
1	"	"	"	4⅜	"
2	"	"	"	4¾	"
1	"	"	"	4⅞	"
1	"	"	"	5⅛	"
1	"	"	"	5⅜	"
1	"	"	"	6⅛	"
1	"	"	"	6⅜	"

Altogether on the above two days, 11 healthy puparia were found at depths in the soil ranging from three inches to six and three-eighths inches. In addition other puparia were collected but as these were within five inches of the surface, the exact depths were not noted. A close watch for larvæ was kept but none were observed.

The flies from the above puparia emerged during the period, May 12th to 18th.

The above observations bear out our previous supposition that the usual stage in which the insect winters in Canada is the puparium stage.

Control Experiments.

Poisoned Bait Spray Used.

The poisoned bait spray which has been used in our experiments in 1916 and 1917 is the one referred to in our Entomological Bulletin No. 12, as follows:—

Sodium arsenite	5 grams (close to ¼ oz.)
Molasses	1 pint.
Boiling water	1 gallon.

The sodium arsenite was first dissolved in the boiling water and the molasses then added. When the mixture had cooled it was ready for use.

In both years we used a plot one-half acre in extent. In 1916, our work was largely interfered with owing to rains which fell, in several instances soon after the applications were made. Notwithstanding, however, such adverse weather conditions the results from the experiment were certainly of a very promising nature. In 1917, the experiment was continued on the same farm and our results were indeed most satisfactory. Applications of the poisoned bait were made by Mr. I. T. Barnet, who assisted in this work, on June 13 (plants about four inches high) 20th and 27th, and July 4th and 16th—five applications in all. On this latter date the onions were about one foot high on the average and were making such rapid growth that it was decided no further applications would be advisable. The flies were readily attracted to the bait and on occasions, a day or two after the mixture was applied, dead flies were easily found which had fed upon it.

The mixture was applied as coarse drops from a watering can with a small hose. The half-acre plot was quickly gone over. Mr. Barnet began at one end

and walked diagonally across the crop continuing from one side to the other in a V-shaped manner, the strips where the liquid would fall being about 15 feet apart at the wide end.

From the half-acre plot 115 bags of good onions were harvested. The stand was certainly an excellent one considering the season. In two other nearby plots of the same size, which were not sprayed, the work of the onion maggot was readily seen and it was estimated that 20 per cent. of the plants were infested.

These experiments were conducted on the farm of Mr. I. A. Farquharson, near Rivermead, Que., which is close to Ottawa. We are very grateful to Mr. Farquharson for allowing us the use of his plots and for his kindly interest and assistance in our work.

The cost of controlling the onion maggot with the above mixture, under conditions prevailing in 1917, was about $1.10 per acre. This estimate includes the cost of the ingredients, as well as a charge for the labour required to apply the five applications. In cases where areas containing several acres were to be treated, the cost per acre could, we think, be somewhat reduced.

From the work which has been done near Ottawa, the results of which correspond with similar work accomplished elsewhere, it seems to us that the commercial grower of onions, in districts where the onion maggot is a regularly occurring pest, should test out the value of the mixture under his immediate local conditions. The cost of the materials is slight and the mixture can be applied quickly even where a number of acres are to be treated. One acre can be treated in less than ten minutes.

Prof. Caesar: What is the formula for the poison bait referred to?

Mr. Gibson: Five grams sodium arsenite, one pint cheap molasses, dissolved in one gallon of boiling water. We did think of trying mixtures containing slices of onion, which by some were thought to make the bait more attractive to the flies, but we did not think this would make any appreciable difference.

Prof. Caesar: Is there any injury to the plants by the sodium arsenite and molasses, and also will you tell me just exactly what you mean when you say that it is spread diagonally on the field?

Mr. Gibson: There was no injury to the plants from the use of this mixture. So far as the method of spreading the bait is concerned, the operator walks across the field at one end, and continues crossing the field back again to about fifteen feet from where he first started, so that it is spread over the field in a V-shaped way.

Prof. Caesar: Backwards and forwards?

Mr. Gibson: Backward and forwards across the field. It is not necessary to apply it all over the onion patch. It is usually applied in the form of large drops.

Prof. Caesar: And the flies feed on the drops?

Mr. Gibson: Yes. We found them feeding readily on the mixture.

Prof. Caesar: Was there any difference in the amount of infestation in the adjacent rows of the adjoining plots?

Mr. Gibson: We found the infestation in the adjoining plots to be rather evenly divided.

Prof. Caesar: My idea was that in those adjacent patches you would expect less infestation than you would get further away, for the reason that the insects would be nearer the bait and would therefore be controlled by it, to a greater extent. For this reason of course you can always get better results by treating large areas.

MR. GIBSON: The chief object, of course, is to control the outbreak early in the season, that is to say during the pre-oviposition period.

MR. BRITTAIN: How long is that period?

MR. GIBSON: In the onion maggot about ten to fourteen days; in the cabbage maggot six to seven days.

MR. BRITTAIN: I have tried controlling the cabbage maggot by poison bait placed in shallow pans. The eggs of the maggots were on every plant in the field. I believe that Mr. Sanderson and his staff were working on the onion maggot in the same way, and he claims that their results were very successful. An account of this appears in the last report they got out. They made this treatment in the pre-oviposition period.

THE ENTOMOLOGICAL SERVICE OF QUEBEC.

GEORGES MAHEUX, PROVINCIAL ENTOMOLOGIST, QUEBEC.

From an entomological standpoint, America presents this difference from Europe, that she gives hospitality to a greater number of parasites. Even if they are imported from the old countries, these parasites are working more havoc here than in their place of origin. The New Continent, however, affords the Old World a striking example in regard to the creation and organization of various services susceptible of helping the public and more particularly offering appreciable advantages to the agricultural community.

Whilst over there private initiative is often left to its own resources, on this side of the Atlantic, governments, following a different policy, endeavor to give birth to movements, to guide and support them. Thus, it becomes comparatively easy to avoid dangers and to attain the aim in a quicker and safer way.

And we could not find a more convincing illustration of this statement than the creation of the numerous entomological "bureaus" already in operation in North America.

HISTORY. It was in the year 1913 that the Government of the Province of Quebec entered this path. Consequently, the history of her entomological service is rather short. In fact, it is hardly four years since our regulation *for the protection of plants* was voted and assented by the Legislature. Nevertheless, the appointment of a Provincial Entomologist dates back from the year before, and it is a disciple of the pioneer of entomology in our Province who became the titular of this post.

It is, indeed, Provancher, this great apostle of science, who stirred up and developed in my predecessor the love for natural history and who lead his first steps. L'Abbé Huard was admirably well prepared to fill the important function to which he had just been appointed. A perspicacious observer, advised naturalist, indefatigable collector for more than thirty years, author of a treatise of Zoology, director since twenty years of *Le Naturaliste Canadien*, curator of the Provincial Museum, he had been good enough to place at the disposal of his country, his extensive knowledge, his wide experience and to devote the last years of his active life to the agricultural class. He organized the Bureau of Entomology, wrote out the law *For the Protection of Plants*. In June, 1916, he published quite a considerable bulletin on "Les Principales Espèces d'Insectes Nuisibles et de Maladies Végétales." But his health, shaken by incessant labour, not allowing him outside excursions, was betraying his energy, and he had to withdraw to a less disturbed life in the month of July of the same year.

The writer of these lines was called upon to succeed him. This was rather a heavy burden for young shoulders to support, but youth has great boldness, and this proverb is often true that says "Audaces fortuna juvat." Confident in the truthfulness of this Latin proverb we have assumed the task and have set to work. Our programme may be summed up as follows:—

INSPECTIONS. The vegetation season requires our presence nearly everywhere in the Province. According to the law, the entomologist must, in the first place, make the official inspection of commercial nurseries between June 15th and September 15th. There are presently about ten large nurseries and some thirty of small or medium area, most of them connected with the Fruit Stations of the Department of Agriculture. These visits require a good part of the summer. Meanwhile, we have to answer to the alarm calls uttered here and there by unfortunate proprietors fighting against an invasion of insects; in most cases we have to take a trip to the battlefield with a view to bringing into action the army of remedies. Occasionally, these trips will afford the chance to make experiments on the control of various insects. Moreover, instructors, disseminated all over the Province are charged with visiting orchards and gardens and have to report—on special forms—on insects which are found by them. This enables us to judge with perfect knowledge as to the territory which requires our efforts.

PROPAGANDA. In a country still young, particularly in the implanting of new ideas, the key to success lies in the education of the people. Our desire is to acquaint all growers with the enemies of their plants, we are desirous to familiarize them with the best preventives and remedies; finally, we are anxious to convince them of the imperative necessity of following our advices without any delay.

This is a work of propaganda, work that is often lengthy and the success of which is depending, in short, on the sole virtue of perseverance. Once this result will have been obtained, we believe that the struggle against injurious insects will be on the eve of being general. With a view to reaching this end, we endeavour to collaborate to all publications which are circulated amongst the agricultural mass. We also take advantage of bulletins, circulars and lectures. Even fairs or exhibitions have been given a test as a means of teaching the public, and I think I am right in saying that this initiative has met with fruitful results.

COLLECTIONS. In concurrence with our inspection trips, we gather the elements of an economical collection that will remain the property of the Department of Agriculture. In this work, I am pleased to say, several collaborators give us their valuable help. I will particularly mention the instructors of the Horticultural Service and the officers of the Forestry Branch to whom the entomologist is indebted for many specimens. In connection with this collection work, we will mention the fact that we aim to the instruction of the young people of rural schools and that we encourage the formation of small collections for school museums. The child's curiosity is very much aroused by this interesting work; when he has grown a man, with greater knowledge, he will be better equipped to enter the struggle. Besides, we will have printed, very shortly, for primary schools, a series of wall maps or posters showing injurious insects and the means at our disposal to combat them; in this manner, we expect to be able to vulgarize rapidly amongst school pupils the elementary knowledge of plant protection.

Our collection comprises the six following items:—

1. Insects injurious to vegetables.
2. " " fruit trees and shrubs.
3. " " cereals.
4. " " forest and ornamental trees.
5. " " animals, men, houses.
6. " " miscellaneous.

General Work. The office work necessitates quite a voluminous correspondence if one thinks that the service is a new departure and the question a recent one, at least officially, in this country. Every day provides its share of inquiries of all kinds, chiefly looking for information as to the remedies to be applied in the case of some injurious insects. We see to it that the laws regulating our service are carefully observed and lose no opportunity of trying to complete this regulation. We will submit, within a short time, to the approval of the Hon. Minister of Agriculture, a project of by-law intended to regulate the sale of fruit trees and shrubs.

Here, I take the liberty to make a suggestion. I am of the opinion that our work will never bear good results and many efforts will be lost if we do not have, in the near future, a general by-law obliging every grower to spray his cultures. This is practised in several countries, with success and the same regulation could be enforced in Canada. In the fight against some species which are largely spread, we enroll school boys and girls; the results obtained have proved excellent and will be more so in future. Our Department relies on the Federal Branch for the making of experiments and researches; however, it does not fail to do its share and efficiently co-operates with Ottawa. Finally, we are working in close harmony with the Chief of the Horticultural Service, who does his utmost to procure to the Horticultural Societies or to their members, the best kinds of sprayers at fair conditions. The same method applies to insecticides.

To conclude, I will say that we are now organizing in Quebec, an Entomological Society which will soon be in operation. When this is an accomplished fact, we will come and ask our affiliation to your society. I am sure in advance that our request will be favorably received. The mother society which is yours, could not refuse to adopt a new daughter without losing her distinctive character.

But this shall not be and we will work in co-operation with you to enlarge and make prosperous the Entomological Society of Canada.

Prof. Lochhead: Mr. President, I should like to say a few words about the good work done by Mr. Maheux. I have been in a position to see some of his work, and also the work of the Department at Quebec. I knew his predecessor, Abbé Huard, very well, and I was delighted when Mr. Maheux was appointed. I should like to say a few words to those from the West regarding entomology in Quebec—what is being done by our friends and by the Department at Quebec. We have, I think, under-estimated the work done in Quebec in the past. I do not know if you are aware that Canon Huard has written a very interesting article for the Quebec Society for the Protection of Plants Report, giving the history of economic entomology in Quebec. He says that there is no province in the Dominion where more entomological work has been done than in this Province. He refers to the various reports that have been published by the Department; to Provancher and his works; to different systematic treatises that have been published since his time; to the various collections of insects, etc., in the Province, of which he mentions that he knows personally of 20 collections in large seminaries; but he left the impression that there are far more than this if we could only

find them out, for there are many silent workers in all parts of Quebec who are adding to the store of knowledge, working among plants and insects. Some of these workers have come from France; they have introduced this science into Quebec in the schools, and the work of Mr. Maheux at the present time is not, therefore, what we may call a new work. Probably Ontario got a little ahead in having a Provincial Entomologist, and in some other enterprises, but we must not conclude that because Ontario is ahead along certain lines it is ahead in every line. We have only to go through some of the museums in Montreal—Laval, McGill and some of the other colleges—to see what has been done. As an Ontario-born man I wish to acknowledge the great work Quebec has done in entomology.

Prof. Caesar: I should like to congratulate Mr. Maheux on the programme of work that he has made out for himself. I consider it a very adequate one, and it contains a number of suggestions that I think other provinces would do well to adopt. I was much interested in what he said about the work in the public schools; I have seen the charts he refers to, and I think they are particularly good, and the coloring is true to nature. They should be a very great source of value, and the children should learn more easily by this method, thus making it easier for the teacher. Some of his remarks, too, I think might be of use in connection with the subject of how entomologists can help in the production and protection of food supplies. I welcome Mr. Maheux as a brother provincial entomologist; I shall be very glad to co-operate with him and expect to receive from him help that will be of much value. I am sure we are all pleased to welcome Mr. Maheux among us as one of our members.

SOME IMPORTANT INSECTS OF THE SEASON.

L. Caesar, O. A. College, Guelph.

The Blackberry Leaf-miner (*Metallus bethunei*, MacGillivray).

From time to time the last ten years there have been outbreaks in Southern Ontario of a Blackberry Leaf-miner, which Dr. A. D. MacGillivray says is a new species, *Metallus bethunei*—very closely allied to *Metallus rubi*. So abundant are the insects in these outbreaks and so many mines are made in the leaves that whole fields of blackberries look as if blighted. One of these outbreaks occurred this year at Burlington on Snyder blackberries. When last visited, October 20th, fully 60 per cent. of the total leaf surface was mined and numerous larvæ were still feeding.

Life History. No special attempt has been made to make a close consecutive study of the life-history, but from notes made since 1910 the following facts are gleaned: There are two broods in a year; the adults of the first brood in warm seasons begin to appear about July 1st, but in cooler seasons are evidently considerably later. Eggs are laid in the tissues of the leaf, chiefly beside the main ribs. The female inserts her ovipositor through the upper surface and forces it down to, but not through, the lower epidermis and the egg is placed close to this. Eggs are very pale white or almost colorless, oblong and slightly curved. They swell before hatching and the lower epidermis, thus raised, shows clearly even to the naked eye where they are placed. I counted 61 eggs on one leaf. Mr. Aiton, my assistant, counted 150. The larvæ soon after hatching begin to make irregular shaped mines, and by the time the fruit is ripe (as

judged by this year) the larvæ of the first brood are for the most part full grown, and have begun to leave the mines and enter the soil, where they construct a firm little oval earthen case about 5 mm. long by 4 mm. wide. Inside this they pupate. The cases found were from 1 to 2 inches below the surface. The adults of the second brood begin to appear after a couple of weeks and this year were still present in countless numbers by September 21st. Egg-laying was then at its height. A few larvæ of the second brood can be found in leaves as long as these remain green. I found them at St. Catharines one year near the end of November. Most, however, have entered the soil long before this and constructed their earthen cocoons. The winter is passed in these in the larval stage.

Fortunately, this pest does not begin to injure the leaves until two or three weeks before the fruit begins to ripen, and much of the fruit, at least this year, was off before the mines of the second brood were made. Yet in spite of these

Work of Blackberry Leaf Miner.

factors the insect must do considerable damage in the way of weakening the plants and lessening next year's crop. It certainly makes the owner much alarmed lest it will ruin all his plants.

Methods of Control. Cultivation of the soil in late fall and the early part of the next season suggests itself as a practicable method of control, but is ineffective; probably because the cocoons are not easily broken.

It has been suggested by some writers that kerosene emulsion would penetrate the dead portions of the leaf and kill the larvæ, but it does not do so. Black-leaf 40, as shown by Herrick, will kill the larvæ of some Saw-fly Leaf-miners in their mines, but it has no effect upon this species.

Having failed to kill the pupæ or larvæ I next thought it possible to poison the adults. These apparently remain exclusively on the leaves and find their food there. I do not remember seeing one anywhere else, not even on the fruit, neither does Mr. Aiton. Accordingly I made a preliminary test of spraying the leaves with sweetened arsenate of lead and to my delight the adults could almost at once be seen feeding upon it. Encouraged by this, I assigned to Mr. Aiton the

task of making definite caged tests with large cheesecloth cages over individual bushes. Cheesecloth was placed also over the ground beneath these cages to make counting dead flies practicable and also prevent new adults coming up out of the soil.

The cages were as follows:—

Cage 1.—Bush sprayed with arsenate of lead in water sweetened with molasses.
Cage 2.—Bush sprayed with arsenate of lead in water without sweetening.
Cage 3.—Bush sprayed with calcium arsenate in water without sweetening.
Cage 4.—Bush unsprayed as check.

In each cage 60 adults were placed.

Results at end of 30 hrs.
Cage 1.—13 dead.
" 2.—12 "
" 3.—25 "
Check 0 "

Results at end of 52 hrs.
Cage 1.—53 dead.
" 2.—51 "
" 3.—60 (all) dead.
Check 8 dead.

Results at end of 72 hrs.
Cage 1.—58 dead.
" 2.—60 (all) dead.
" 3.—60 " "
Check 18 dead.

From these tests it seems quite clear that this species of Saw-fly can be poisoned in the adult stage and that molasses is not necessary for the purpose. The question then arises as to when to do the poisoning. It will have to be done before the adults appear in July, and it seems to me the proper time will probably be just before bloom, or just after most of the blossoms are off and the fruit is still so small that there will be no likelihood of the poison being on it when ripe. A second application will possibly be advisable just after picking. Arsenate of lead will probably be the safest poison and if applied heavily without molasses should remain on the foliage for a month or more. Arsenate of lime kills more quickly but would be more likely to injure the foliage, though none of the spraying either in cages or on the part of the row I treated myself, even where molasses was used, caused burning.

I hope to make a careful trial of the poison treatments this coming year and to give a further and more definite report next year.

Zebra Caterpillars (*Ceramica picta*).

In September and October of 1916 there were several turnip fields in Peel County and probably in many other unreported parts of the Province that were severely injured by the Zebra Caterpillar. As it is rare that this insect becomes very numerous I did not expect it to cause much trouble this year, but to my surprise it has been very abundant in many counties west of Toronto and has stripped many a turnip field of all or almost all its foliage. Many fields were thus defoliated by the end of September, thus preventing almost a whole month's growth. Cabbages were also attacked. The larvæ were found feeding on several other plants.

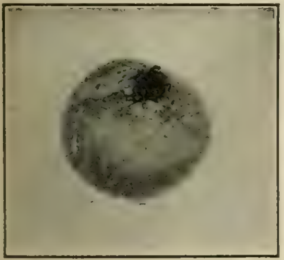
Five kinds of control measures were tested, but only one proved at all satisfactory, namely dusting with Paris green mixed with 20 times or more its bulk of air slaked or hydrated lime. Any other fine, moderately heavy substance such as land plaster should do as well as the lime. I thought that possibly the

Zebra caterpillar and moth.

poison bran might work, though the feeding, or rather the resting habit of remaining on the leaf except in wet weather, made it doubtful whether they would ever seek or find the bran. The result showed that while a few did come in contact with it and died, about 90 per cent. did not.

CODLING MOTH (*Carpocapsa pomonella*).

A remarkable thing about this insect this year was the great number of side injuries it caused all over the Province. This was especially noteworthy in Niagara, because most of the side injuries there are ordinarily caused by the second brood and are made during August and September, but this year about



Dark castings at calyx end, showing where Codling Moth larva usually enters the apple.

Adult Codling Moths, natural size. (After Slingerland.)

90 per cent. of these were to be seen by about the first of August. I have notes on this subject made on August 4th and again on September 15th and October 20th, and the estimate of the percentage of injured fruit on the first date is almost the same as on the last. This shows that it was the first and not the

second brood that was responsible for these side injuries, in fact there was only a very small second brood this year even in Niagara district.

It seems to me we may possibly account for the larger number of side injuries this year in two ways. (1) There were very few apples and hence more larvæ would attack these apples than if there were a larger crop. (2) Many of the moths emerged very late and laid their eggs after the pubescence was off the little fruits, and in the absence of this entered the side of the apples much more readily than if the pubescence had been present. A poison spray three weeks after the blossoms fell gave good results this year in all cases where it was well applied.

THE WHITE-MARKED TUSSOCK MOTH (*Hemerocampa leucostigma*).

Judging from the number of egg masses to be seen this autumn the Tussock Moth will be very abundant in many of our cities and larger towns next year. Complaints have already come in from as far east as Belleville and as far west as Goderich. In Toronto I counted 500 egg masses on a single maple tree in the Exhibition Grounds.

Not only are the egg masses abundant in cities and towns but also in many orchards. One wide awake young fruit grower said to me a few days ago that in his opinion this would be one of our main orchard pests next year in Western Ontario. In Niagara it is likely to do a good deal of damage and if it is not destroyed will in apple orchards injure a large percentage of fruit.

Work on apples of the larvæ of the White-marked Tussock-moth.

In destroying the insect in orchards and for that matter also on shade trees, a person is very likely to overlook the egg masses concealed in leaves. This spring I asked my men to remove the eggs in one of our experimental orchards, but did not call their attention to the leaves. On visiting the orchard again I saw that these had been overlooked so that the work had to be done again. Mr. W. E. Biggar, the Provincial Fruit Pests Inspector, has used a small wire brush about six inches long and one inch wide and fastened to the end of a pole. A single stroke of this tears the egg masses to pieces. This brush has been used in St. Catharines and some other places and given satisfaction. In my opinion it is very good for the lower part of trees to the height of say 15 or possibly 20 feet, but above that I think a hook, especially if toothed along the sides and ends, will prove better. A test of crude creosote was used, but it seems to me

this will prove very unsatisfactory. I cannot help believing that it does not penetrate through in many cases and so does not kill all the eggs, at any rate it did not seem to me to have done so even when eggs were examined several days after treatment.

The removal of egg masses when numerous on tall trees is a very great task. I observed that many of them, in fact a very considerable percentage, were situated near the top of the trees in the crotches of branches, often not more than one inch in diameter. Fortunately, egg masses seem on lateral branches to be situated either in the crotch or on the underside, not on the upper side and so can readily be seen. Some, of course, are in leaves attached to twigs or branches. It is very doubtful whether in badly infested city parks spraying would

Larva and adult male of White-marked Tussock-Moth.

not be much cheaper than removing and gathering egg masses. I have written to two firms to see whether we cannot secure at a reasonable price good outfits that will throw a satisfactory spray from the ground to the top of the tallest trees. I do not mean the costly type of outfit used in the Gipsy Moth work. Both companies claim that they can furnish machines that they believe will prove satisfactory.

I should like information from anyone present as to what percentage of eggs would hatch from egg masses removed in late autumn or winter but left lying on the ground, also as to their experience with crude creosote on egg masses.

Slugs.

I have never seen so much damage from Slugs as this year. Beans were their favorite food, and these in many fields were fed upon ravenously and in some cases almost defoliated. Paris green as tested by myself and also by Mr. Baker failed to control them. Lime was not available in the district where I was, but hydrated lime as applied late in autumn killed them if used freely. I am not sure whether it would prove satisfactory on a large scale in spring or early summer when they are most destructive. Lime-sulphur will kill but not at the strength the plants are likely to stand without injury.

The Seed Corn Maggot (*Pegomyia fusciceps*).

This insect caused much injury to beans in many districts.

The Wheat Midge (*Contarinia tritici*).

Wheat in Wentworth, Lincoln, Welland and Haldimand suffered considerable loss from the Midge. In some districts about 10 per cent. of the kernels were affected. Only eight adults emerged this year under normal conditions in our

cages, but we had no evidence that any eggs were laid. The remaining insects either entered the soil to pupate or remained in the wheat heads. Apparently fully 50 per cent. doing the latter.

EIGHT-SPOTTED FORESTER (*Alypia octomaculata*).

Near Toronto the larvæ of this moth were very numerous on grape foliage.

Halisidota tesselaris was unusually abundant this autumn and fed on numerous plants.

Halisidota caryæ attacked in considerable numbers apple leaves in the counties of Elgin, Oxford and Middlesex.

Halisidota harrisii destroyed much of the foliage on sycamore trees in parts of the Niagara district.

Diacrisia virginica was a great pest in gardens in many parts of the Province and attacked numerous flowering and other plants.

Datana integerrima defoliated walnuts in Essex and Kent.

The larva of the Hickory Tussock-Moth (*Halisidota caryæ*).

PROF. LOCHHEAD: Is this Blackberry Leaf-Miner a distinct species from the *rubi*?

PROF. CAESAR: By looking at the two species *rubi* and *bethunei* you would say that they were exactly the same, but Dr. MacGillivray has found a few differences. Both species are black, about 1/4 inch long, and the body is quite black and the legs white, so that it is easy to recognize it as one of the two species. A full description is given in MacGillivray's Tenthredinoidea.

MR. GIBSON: Did you find both species during the work?

PROF. CAESAR: No. Only the one species.

MR. GIBSON: Did you find this pest all through the Niagara district?

PROF. CAESAR: Yes. There is a species this side of Toronto which has also been found almost as far as Port Hope. I do not know whether it is the same.

MR. SWAINE: What was the strength of the spray used?

PROF. CAESAR: The same strength as for orchard sprays, 2½ lbs. to 40 gallons of water.

MR. SWAINE: We have tried kerosene emulsion sprays, just ordinary summer strength, on the leaf surface. I have killed them in strings with kerosene emulsion and also with Black Leaf 40, strong.

Prof. Caesar: In the case of Black Leaf 40 I tried it decidedly strong, and what is more, I put the insects all together in a tight-fitting box so that the fumes could not evaporate easily, and brought them home packed very closely. The fumes had no effect at the end of two or three hours, and they were strong enough to have acted in a few minutes.

Dr. O'Kane: We did some work this summer along the same lines of contact sprays for leaf-miners, chiefly the Apple Leaf-miner. This work was done on quite a large scale, an assistant starting in spring and remaining all summer on the work of penetration of contact insecticides. We worked the previous winter in the laboratory, shaping our results as far as possible. Of course apple is not the same as blackberry, but I may tell you our results. We used a great many different kinds of material including Black Leaf 40, up to 1-50; kerosene emulsion up to 25 per cent.; Black Leaf 40 with soap; lime sulphur at various strengths up to that which burned the tissue. We also used chemical reagents. We tried these through two generations of the Leaf-miner, the first spray when the Miner just hatched, the second when it was ¼ in. long, and the third when it was full grown. We made no penetration whatever into the mines with any substance, except through advantageous openings. If the Miner happened to be next to the mine where there was a good puncture, it got killed; if it was in the middle of the mine it did not get killed. If it was at the far end of the mine it would not be harmed in the least unless the application was sufficiently strong absolutely to destroy the leaf itself, when, of course, the miner was killed too. Pupation would go ahead as usual. As I say, if there happened to be an opening or puncture the material would penetrate, but if there was no such puncture the Miner had a perfectly satisfactory and efficient shelter. I am not certain with regard to elm leaves, but this prevails in the case of apple leaves.

Prof. Caesar: May I ask a question and suggest an answer? I want a whole lot of information on how to control slugs.

The President: This has been a most serious problem with nearly everyone on account of the wet season.

Mr. Gibson: At Ottawa this year we have been using air slaked lime.

Prof. Caesar: Have you tried hydrated lime?

Mr. Gibson: No; only ordinary lime.

Prof. Caesar: I found last week or the week before when making some further experiments with hydrated lime that at this time of the year it will kill slugs, but whether it would kill them earlier in the seasen I do not know. I do not know whether it would have any injurious effect on the foliage, say of beans. Lime sulphur if applied very strong will kill slugs, but it has to be too strong and will injure foliage. Hydrated lime when it comes in contact with a liquid forms a pasty substance. I should like to know if anyone else can suggest any other remedy.

Dr. Corcoran: Last season in the garden everything was eaten up by slugs around Notre Dame de Grace. Almost all the lettuce and cucumber patches were spoilt, and even pumpkins were eaten. We would find a pumpkin with a good-sized hole eaten in it by slugs. We tried hand-picking, but that was the only remedy we tried. How is the lime applied?

Prof. Caesar: You can apply the lime in the evening when the slugs are at work. They work on top of the leaves and by dusting you can get the lime in contact with them. I think this is better than applying it in liquid form, and would have a more lasting effect.

MR. BAKER: When was it applied?

PROF. CAESAR: We got the best results by applying it in the evening just before the slugs come out to feed.

MR. GIBSON: We tried this remedy in connection with beans. I would recommend dusting freshly slaked lime every evening before the slugs come out, and when they eat the lime it kills them. If I remember correctly, we had very little trouble afterwards.

PROF. CAESAR: The slugs do not seem to be killed with Paris green. Mr. Baker tried, and it killed so slowly that it was not looked upon as a satisfactory method.

PROF. BRITTAIN: Slugs did not appear with us this year to any extent. We were going to make some extensive experiments this year, but there were no slugs.

PROF. LOCHHEAD: Has anyone ever tried poison bait with any success?

PROF. CAESAR: No success.

PROF. LOCHHEAD: The old English remedy of course is slaked lime. Whether it is effective all the time or not I do not know.

PROF. CAESAR: Tobacco extract does not have much effect upon slugs, but millipedes are usually poisoned by it.

THE APPLE AND THORN SKELETONIZER (*HEMEROPHILA PARIANA* CLERCK).

E. P. FELT, STATE ENTOMOLOGIST OF NEW YORK.

A small European moth which we have termed the apple and thorn skeletonizer has become well established in Westchester and Rockland counties, the centre of the infestation being near Irvington and Nyack, respectively. This insect is classed as one of minor importance in Europe though this is not necessarily to be the case in America. Some of our most destructive insects are of relatively slight importance in their native country. Owing to the fact that the caterpillars feed upon the upper surface of the leaves, it is easy to apply a poison where it will do the most good. It should not be difficult to keep this pest in control until its status can be determined or natural enemies have an opportunity to assert themselves and prevent widespread and material damage. This insect is already sufficiently numerous near the centre of the infested area to defoliate entire orchards and conditions favor a continuation of the spread with its accompanying serious injury unless there is early, thorough and general spraying in the infested area next summer.

RECOGNITION CHARACTERISTICS. The work of this newly established pest is fairly characteristic. It skeletonizes the leaves in much the same way as the well-known canker-worms, except that these latter more usually devour all the vital tissues of nearly every leaf, whereas this newly introduced caterpillar generally confines its attack to portions of many leaves, feeding near the centre under a slight web and extending upward and outward to include most of the tip of the leaf and frequently turning and webbing down margins of leaves about half an inch wide. Areas on each side of the basal part of the leaf are often untouched. There is no webbing together and inclosing leaves in masses so characteristic of

the native fall web-worm and also seen to a less extent with the brown-tail moth caterpillar. The cause of this mischief is an active, yellowish, black-spotted caterpillar about half an inch long.

Description. The moth is an obscure grayish brown or dark brown, sometimes purplish tinged, insect with a wing spread of a little less than half an inch. There is in well marked specimens near the base of the fore wing a rather broad, broken, angulate dark band near the basal third and a less distinct and more regular but somewhat broken dark band near the distal fifth, an area between this and the basal third being a variable grayish. The fringes of both the fore and hind wings are a rich purplish brown.

Pupa. Length about 1/4 inch, moderately stout and dark bronzy yellow, variably marked with fuscous, especially on the posterior abdominal segments. The head is dark brown with a few fine, moderately long hairs. Antennal cases slender, the variably yellow-mottled wing cases extending to the sixth abdominal segment, the leg cases reaching just a little beyond. The mouth-parts and most of the median ventral area between the antennal cases yellowish. The dorsum of the thorax dark bronzy yellow. Scutellum fuscous yellowish and with a very fine short pubescence. Dorsum of the abdominal segments moderately smooth, shiny, the segments when flexed ventrally showing along the anterior margin series of minute closely set teeth. Terminal segment yellowish.

Cocoon. The cocoon is spun upon the upper surface of the leaf and consists of an elongate oval mass of thick white webbing about 5/8 of an inch long and 1/4 of an inch wide. It is frequently near the midrib and covers the true cocoon which is faintly seen beneath. The pupa wriggles out partly from under the webbing before the moth escapes, the pupal shell projecting as in the Sesiids.

Larva. The caterpillars are quite variable in appearance. The smallest observed on the leaves were about 1/8 in. long, mostly pale greenish yellow. The head is a distinct amber shade with a rather conspicuous dark brown mass of closely placed ocelli. There is a narrow irregular dark brown line at the lateral dorsal angles of the head case, a small black fuscous spot ventrally and a pair of small subtriangular black spots sublaterally. Antennæ moderately prominent, mostly yellowish brown, slightly fuscous apically. Thoracic and abdominal segments mostly a uniform yellowish, the true legs pale yellowish and having the second segment fuscous and the distal segment much more slender, tapering and with a distinct claw apically. There are well-developed cylindrical abdominal prolegs on the third, fourth, fifth, sixth and terminal abdominal segments, each leg when extended with a length approximately three times its diameter. The tubercles are a pale fuscous or fuscous, depending on the age of the caterpillar, each bearing one or two moderately long hairs.

Older larvæ with a length of about 3/16 of an inch are decidedly darker though the general color is practically the same. The tubercles are much larger and in some specimens almost confluent so as to give the appearance of submedian black lines, though in reality they are simply series of closely set tubercles. The thoracic legs have a shade of fuscous on the apical portion of the basal segment, the second segment is black and the third practically as in the earlier stage.

Full-grown caterpillars have a length of nearly half an inch and present practically the same characteristics as given above, there being some darker specimens with rather larger black tubercles and lighter ones with somewhat smaller tubercles.

Distribution. This insect is probably widely distributed, since it has been recorded from England, France, Germany, the Balkan Peninsula, Bithynia and

west in Asia to Turkestan. This range suggests that the species can maintain itself in the northern United States and southern Canada.

It has become established in New York State in an area determined in co-operation with Dr. G. G. Atwood of the State Department of Agriculture as centering approximately upon Irvington and extending east to White Plains, south to Harrison and north to Croton. It also occurs on the west bank of the Hudson River, ranging for a mile or two north and south of Nyack and west to West Nyack.

Life History. It has not been possible to work out the complete life history of this insect under American conditions though there is no reason for thinking that the moth has departed materially from its habits as recorded in Europe. Mr. J. W. Tutt states that adults occur in September and October on flowers of Compositæ, while William West records capturing specimens among golden-rod.

The adults and probably pupæ hibernate, the former in any shelter such as thatch and the latter in cocoons attached to the leaves. The over-wintered moths or those issuing from pupæ deposit eggs probably when the leaves are partly developed, since Meyrick records larvæ as occurring in England during May, June and August, indicating at least two and probably three generations annually. There is considerable variation in development toward the end of the season, at least under American conditions. Full-grown and very small larvæ were found simultaneously at Irvington in September and even in early October. A few larvæ may feed to the latter part of the month. Larval growth is probably completed within a month or six weeks. The type of injury suggests that the moths deposit a few eggs near the base of each leaf and when numerous may oviposit on almost every leaf. One of the striking features of an infestation is the general distribution of injury throughout the tree.

The feeding on each leaf is, practically speaking, independent of that upon other leaves. There is no inclosing and webbing together as with the fall webworm. The caterpillars feed upon the upper surface, skeletonizing the leaves more or less completely and working from the lower part of the midrib upward and outward so that unless the infestation is unusually severe areas on each side of the basal parts of the leaves frequently remain untouched. This type of injury is characteristic of moderately infested orchards. Those badly infested may have practically every leaf on all the trees completely skeletonized.

Food Plants. This insect has shown a marked preference for apple though it has also been recorded as feeding upon pear, hawthorn, mountain ash, birch and possibly willow.

Natural Enemies. Meyrick's statement to the effect that this skeletonizer is local in England indicates moderately efficient enemies and this is borne out by its classification as a pest of minor importance by continental writers and the recording by Reh of a number of parasites. It is presumable that some of its native enemies became established with their host and if this is not the case, the chances favor some of our native parasites becoming accustomed to this new food supply and assisting materially in reducing its abundance. A few parasites (*Dioctes obliteratus* Cresson) kindly determined through the courtesy of Dr. Howard, have already been reared from materials received from Westchester County.

Control Measures. There is no question but that thorough and timely spraying with a poison such as arsenate of lead will destroy these caterpillars and, owing to their feeding almost entirely upon the supper surface of the leaves,

a general application of these measures in infested areas to all trees upon which the pest can subsist would mean its early control and practical elimination so far as material damage is concerned. Residents of the infested section are most strongly advised to watch for the development of the insect next season and to spray all trees showing signs of its work, since it is very important to control it so far as possible, because experience has demonstrated that it is easier to handle an outbreak in its incipiency than to begin after serious losses have occurred.

SOME NOTODONTIAN LARVÆ.

Rev. Dr. J. A. Corcoran, Loyola College, Montreal.

The sudden appearance of temporary structures and protective colours and markings of caterpillars are usually attributed to the action of stimuli from without. Whether this deduction will remain unshaken by the facts that the observers of the future may bring to light, or will be discarded, does not concern us. It is sufficient that this theory gives the entomologists of the present day a spur to observe more closely the changes which various larvæ undergo before reaching the stage of pupation, and makes of their observations the solution of a definite problem instead of the compilation of a catalogue of uncorrelated changes. For the external stimuli which have acted in the past must be more or less active to-day, otherwise the structures they have produced will become useless and vestigial, since God in His goodness does not allow a creature to retain a structure, that is a functioning structure, which has become really hurtful to its possessor.

In an endeavour to find a cause for the abrupt appearance of certain colours and temporary armament in the Notodontian larvæ, I had under close observation last summer some colonies of *Schizura concinna* and *Heterocampa guttivitta*. My observations of the habits of these larvæ were too restricted, and my microscopic examination of the sections of the parts before and after the changes were too superficial, to be of value in arriving at a definite conclusion, but I give them in the hope that some of our members may find them of interest and later when the win-the-war problems no longer call for the entomologist's undivided attention, they may record their own studies on the larvæ of these same species.

When first seen the larvæ of *S. concinna* were about 3 mm. in length and arranged themselves in serried ranks on the under surface of the leaves of an apple tree. I divided the colony into two, leaving twenty larvæ undisturbed and placing the rest on a nearby branch of the same tree, so that I might have material for dissection while not depopulating my observation colony. The moth had deposited her eggs on the end leaves of a branch most conveniently placed where they could be seen at all hours of the day.

During the first stage the larvæ fed on the epidermis and tissue of the under side without puncturing the leaf, and hence could not be seen from above. Their yellowish heads which were smooth and unarmed, and their yellowish-green bodies, tinted reddish along the sides, harmonized so well with the surface on which they fed that it was difficult to distinguish them. Neither insects nor birds seemed to spy them, although a dozen two-winged flies passed within a few feet of them, and an aphis lion was seen running about on the lower part of same branch on which the colony fed. The third day after discovery all the members of both colonies moulted and passed to the second stage.

The head was now reddish-black and bore two blunt knobs on top. A section of a larva made the day before the moult shows no evident thickening of the epidermis and underlying tissue. As the insects grew, red lines along the sides of the thorax, a pair of yellow spots and five tubercles of the same colour near the anal end of the uplifted abdomen could be made out. By the time the larvæ were 8 mm. long they were eating both surfaces of the leaves and when feeding arranged themselves along the cut edges. Hairy warts on the head, and dorsal and lateral spines on the body gave the insects, which could now be seen from above, a rather unattractive look. When not feeding the larvæ placed themselves in rows on the stem and bared veins of the leaf.

The numerous two-winged flies which were seen on the leaves of neighbouring apple trees, did not seem to notice the colonies. One larva dissappeared at this stage—perhaps, to the nest of one of the wasps which were decorating the cornice of a near-by room.

After the second moult the head became black again and remained so until the final moult. The various tubercles and spines were more marked and the insects, which were at this time denuding the branch, eating even the veins and midrib of the leaves, could now be seen at a distance of six feet. Numerous insect-eating birds hopped about on the near-by trees and some stopped to examine the colonies. A young song-sparrow disposed of one larva, but the other six which disappeared during the third and fourth stages succumbed to the heavy rains which were of frequent occurrence last August.

At the final moult the larvæ developed the coral-red head and large abdominal hump of the same colour which gives them the common name of the Red-Humped Apple Worm. During the last days of the fourth stage I took a number of larvæ from the control colony that I might make sections of them and follow the changes which immediately precede the final moult, but my time has been so taken up that I have not yet examined them.

During the last stage the larvæ increased in size from 20 mm. at the time of the fourth moult to 30 mm., which they attained before descending the tree to pupate. Although they were conspicuous objects which could easily be made out at some distance, the birds did not molest them.

My colony of Heterocampa larvæ were hatched from a few eggs that were laid by a female caught at night. By means of a smear of gum I attached the eggs to the under surface of a red maple leaf. On the eighth day the larvæ emerged and began feeding on the superficial tissues of the leaf. They were then about 5 mm. long and under a glass showed nine pairs of comparatively enormous horns. The first pair on the prothoracic segment were four-tined like the antlers of a deer, the remaining eight pairs were single-pronged. Section of the insect shows the horns to be pure dermal structures devoid of muscle. On the fourth day the larvæ moulted and lost all trace of the horns except a pair of short stumps on the prothoracic segment.

During the first stage no enemies seem to have discovered these larvæ, but on the third day of the second stage while I was absent in the country they all disappeared. Some predaceous insect probably got them, for they were well hidden from the birds.

The individual larvæ of these species experience no change of surroundings which might call for an abrupt change in colour or armament. They pass their whole larval existence on the tree upon which the parent moth deposits the eggs, indeed, they do not leave the branch, unless compelled by lack of food, until they all, in regimental order, descend the tree to pass the winter as pupæ beneath the dry

leaves or in the ground. Nor do the horns of *H. guttivitta* and the hump of *S. concinna* show signs of becoming vestigial, for both are well nourished and the latter bears moveable spines.

Predaceous insects are the usual enemies of small caterpillars, and birds of full grown larvæ. To escape the former the horns of Heterocampa are well adapted, but why should they suddenly disappear at the first moult? The marked increase in size of *S. concinna* during the last larval stage may call for more conspicuous warning colour that the passing bird may more easily see that the insect is not good food. Whatever be the reasons, the entomologist who observes the development of Notodontian larvæ must be impressed by the protection God gives these strange creatures against the enemies who prey upon them.

EVENING SESSION.

The evening meeting was opened at 8 o'clock with an address of welcome by Dr. Harrison, Principal of Macdonald College.

Owing to the fact that he would be unable to remain for the whole of the evening session Dr. Hewitt took this opportunity of introducing the symposium in "Canadian Entomologists and the War," the discussion of which was to take place at the smoker later in the evening.

The public lecture on "The Problem of Mosquito Control" was then delivered by Dr. T. J. Headlee, State Entomologist, New Brunswick, N.J.

THE PROBLEM OF MOSQUITO CONTROL.

THOMAS J. HEADLEE, PH.D., ENTOMOLOGIST OF THE NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS AND STATE ENTOMOLOGIST.

INTRODUCTION.

While interest in anti-mosquito work is now found in nearly all parts of the world, it is engaged in most cases with very limited areas of country. No doubt this is due to the fact that the source of interest is usually the hope of eliminating insect-borne diseases from limited areas.

Anti-mosquito work in New Jersey does not have its roots in the desire to destroy diseases. Malaria, which with us is the only mosquito-borne disease, occurs in only a few very limited areas and forms in each case a strictly local problem. Interest in mosquito control in New Jersey arises from the desire to make the state entirely comfortable and desirable for its citizens.

The north-eastern end of the state is rapidly being transformed from low-priced farm land into urban property and the mosquito pest, such as would come from the unprotected salt marsh, would seriously interfere with and delay that process. In the counties of Hudson, Bergen, Essex, Union and Middlesex, each of which have some thousands of acres of salt marsh within its borders, in the ten year period from 1900 to 1910, 60,000 acres of farm land were transformed into urban property, and the growth during the last seven years has not been less rapid. Within range of these salt marshes lies the County of Passaic, which is really a member of this group, but which has no salt marsh.

County map of New Jersey, showing locations of salt marshes, area of upland formerly covered by flights of salt marsh mosquitoes, portion of the salt marsh which has been more or less completely drained, and area of upland at present covered during the mosquito season with salt marsh broods.

About one and one-half millions of people live within the borders of these six counties.

That part of the southern end of New Jersey included in the counties of Ocean, Burlington, Atlantic, Cape May, and Cumberland have more than 100 miles of fine sand beach nearly all of which might be developed into delightful seaside communities, and 1,700,000 acres of farmland of which about one million are totally undeveloped.

A large part of this territory is covered at times during the summer with dense broods of salt marsh mosquitoes.

Seaside communities build slowly and undeveloped lands are tardily improved under such conditions.

There are about 296,000 acres of salt marsh in the State of New Jersey, of which probably 200,000 are potentially good salt hay land. The drainage necessary to control the salt marsh mosquito seems after its effect is felt to increase the hay yield from about .7 of a ton to 2.6 tons per acre.

While New Jersey was one of the first states to become interested in the problem of mosquito control from the standpoint of human comfort and prosperity, she is certain not to be the last, because there are about 6,400,000 acres of tidal marsh in the United States alone, and the mosquito-borne disease of malaria is now recognized as the great, but by no means immovable, bar to the development of immense areas in our Southern states.

In view of the apparent certainty of a rapidly increasing interest in the elimination of all species of mosquitoes as a means of contributing to human comfort and prosperity, the present paper is an outline of procedure that may be followed in attacking the problem in any specified locality.

To the man not familiar with the nature of insects, anti-mosquito work means mosquito extermination. This misconception leads the professional worker into much trouble because the people whom he is trying to serve demand year by year greater and greater freedom and cannot understand why at times they are troubled.

At the present stage of anti-mosquito work only the problem of control can be considered and that of extermination must be relegated entirely to the future. The object of mosquito control is to reduce the fauna to a point where diseases carried by it do not occur and the householder is unaware of its existence.

The problem of bringing the mosquitoes of any badly infested locality under control involves: (1) A careful and thorough analysis of the mosquito fauna both in larval and adult form for at least one entire season; two or three would be more conclusive; (2) a careful study of the reasonably permanent breeding places from which the adults come, followed by the preparation of a detailed plan showing the methods and the cost of eliminating them; (3) the obtaining of funds with which to do the work; (4) the execution of the plans and the completion of the initial work; (5) maintenance, temporary elimination, and improvement; (6) giving the work a permanent character; (7) evaluation of the results of mosquito control.

Analysis of the Mosquito Fauna.

In planning for future anti-mosquito work the mosquito survey usually means an examination of the territory for places which past experience has indicated as likely to breed and for such places as show breeding at the time of inspection. Unfortunately for this simple procedure, experience has shown that the area may be far more severely infested by mosquitoes which breed outside its limits than by the species that are produced locally. This is well illustrated in New Jersey by all

communities within reach of flights from the salt marshes (see map). Before the flight of certain salt marsh species was recognized many local efforts were discredited by the influx of these far-flying species. It is, therefore, necessary to find some way of determining not only the species that are bred within the protected area, but also the species which breeding entirely outside may invade and annul the effect of local work.

Without doubt the most accurate way of determining these points is that type of a seasonal study of mosquitoes on the wing which will enable the operator to map the mosquito fauna at short intervals throughout one or more summer seasons. It is true that a person having long and wide experience with mosquito control can make a rather accurate guess at the nature of the mosquito trouble in a specified area by a study of possible mosquito breeding places within and without of the said area. His forecast is, however, merely a shrewd guess and may go very wide of the mark.

In the collection of data necessary to the preparation of the mosquito distribution maps a limited number of stations must be selected in such a fashion that some definite idea of the conditions throughout the infested area may be obtained. In order that the collection results may be comparable the places selected must be essentially similar, especially as regards cover and light or the difference between them must be evaluated, which is always a difficult matter. The portion of the body from which the collections are made must be the same, and the collector whose body does not attract mosquitoes must be eliminated. Collections must be made at a time of the day when as nearly all species are active as possible. It may be necessary to determine this time by running a set of trial collections covering all hours of the day and night. For the purpose of comparing one collection with another the temperature, moisture and wind conditions during the period when each area-wide collection is made must be recorded and eventually more or less accurately evaluated.

The mosquitoes must be caught and killed without crushing or rubbing them in order that accurate identification of them may be made. The results of each general collection, stated as so many mosquitoes of each species per selected unit of time should be set down on a topographic map of the area and the nature of the weather conditions noted on the same sheet.

If properly prepared this map will afford a picture of mosquito conditions at the time when the collection was made and if properly interpreted will show whether the collection methods should be modified and will indicate what changes should be made.

If the number of specimens of each species caught appears to be perfectly irregular in distribution the results may be attributed to emergence from local breeding. If on the other hand, there is evident an area in which certain species appear in greatly increased numbers which grow larger from some point in the area to its boundaries, it is safe to assume that an invasion of mosquitoes breeding outside the protected area is occurring. If there should appear specimens of a species, the known habits of which would seem to preclude breeding within the area, invasion of that species would be clearly indicated.

Whenever the charts show the presence of invasions, they must be traced at once to the source from which they come. The method employed in these tracings will depend upon the species concerned. When dealing with the salt marsh or the fresh water swamp mosqu .to, the work may be done during daylight by means of an automobile, but when dealing with the house mosquito, the collections must be made during a period beginning about dusk and ending less than one hour later. In

dealing with other less well known species, it may be necessary to determine the time of day when the study can be successfully made. In any case the kind of weather, the time of day and the type of cover under which the species being studied may be caught must be determined.

Tracing invasions of salt marsh species are done very quickly with an automobile by starting in uninfested territory close to the infested area and collecting at regular distances—say, 0.5 of a mile to 2 miles—until the mosquito zone has been traversed and uninfested country found on the other side; this collection to be followed by a similar one pursued in a line at right angles to the first.

Two assumptions are, of course, necessary to the success of this plan, one of which is that the mosquitoes may be collected in daylight and the other that the direction of greatest density indicates the source of the brood. The collections are made in as nearly similar places as possible, especially as regards the character of the growth, and the relative number present is determined by using two small cyanide tubes and catching specimens as rapidly as possible for a definite period of time, then reckoning the catch on the basis of so many per minute.

In actual practice whenever the study began on the first appearance of the brood, these assumptions were found to be correct and many broods have in this manner been traced to their places of origin. At least three important results followed the discovery and use of this method, the first was the finding of immense breeding areas in the Hackensack Valley salt marsh in sections hitherto thought to be free of breeding, the second was the uncovering of inefficiency in the control of salt-marsh breeding on certain especially dangerous areas, and the third a determined and apparently successful effort to eliminate the breeding places thus discovered.

The methods found to be successful for the fresh water swamp mosquito migrations are essentially the same.

It became necessary to find the source of a brood of the house mosquito (*C. pipiens*) which in spite of effort to control local breeding continued to infest North Elizabeth and Union County. It was quickly found that no progress could be made by day collections and that a difference in the hour when the collections were made gave such a difference in the number caught that determination of density by serial collections covering several hours was impracticable. Accordingly, a sufficiently large number of inspectors were furnished by Union and Essex Counties to cover a line extending through North Elizabeth to and through South Newark to the sewage-charged salt marshes, each man collecting for fifteen minutes at three stations, one-quarter of a mile apart from each other, between 8.00 p.m. and 9 p.m. The following evening in the same manner a line from the marshes running at right angles to the first was collected. In this instance the weather of the two evenings was sufficiently similar to render the results comparable, but generally it would be better to have enough inspectors to collect both lines at the same time.

A careful study of the collections showed a zone of house mosquitoes extending from North Elizabeth to the Ebling section of the Essex County salt marsh, a distance of at least 2.5 miles, with practically steadily increasing density as the marsh edge was approached.

Examinations of the marsh, which was heavily charged with sewage, showed enormous numbers of *C. salinarius* and *C. pipiens* with small numbers of *A. sollicitans* and *A. cantator* in larval and pupal stages. The question has been raised as whether supposed house mosquitoes were not really *salinarius*. Undoubtedly both *C. pipiens* and *C. salinarius* were component portions of the zone,

but the smaller portion seemed to consist of the smaller, darker, lankier form which was thought to be the latter. It seemed only fair to conclude that while *C. salinarius* played a part in forming this mosquito zone, *C. pipiens* was clearly shown in this case to migrate a distance of 2.5 miles from the place of breeding.

At the same time that an analysis of the mosquitoes on the wing is being made a careful survey of the mosquito breeding places should go forward. A seasonal map of the more or less permanent breeding places should be made.

Preparing Plans for the Elimination of Breeding Places.

Having determined the nature of the mosquito fauna and its source, the next step is the preparation of plans for the elimination of the breeding places. In most cases this involves the solution of rather simple engineering problems for most of the work will be of a drainage character. Plans for the adequate treatment of each place should be prepared. The preparation of this phase of the report may involve the consideration of breeding places, either fresh or salt, existing entirely outside of the protected area.

The actual working out of such a plan is well illustrated in the effort at Princeton, New Jersey. Here each breeding place of a reasonably permanent character has been charted. The type of written matter accompanying this chart gives a description of each place or group of places, describes the methods that should be used in eliminating the breeding, and presents an estimate of the cost of the operation. A simple description of one of the breeding places runs about as follows: "District Number V is an old basin once a part of the D. and R. canal system but long since abandoned. The stagnant water is sheltered from the winds by surrounding trees and the banks are shallow and overgrown with vegetation. It is 130 x 300 feet and has some surface drainage into Stony Brook. Its bottom has at certain points as low an elevation as 52.6 feet above sea level, which shows that the drainage will have to be supplemented by a fill.

"The Committee recommends that an open ditch be cut from this basin to the nearest point of Stony Brook at a cost of from $15 to $20, and that the earth thus removed be used to help fill the remainder of the basin to a level of 53.1 feet or more. This will require 2,655 cu. yards. Part of the earth may be taken from the banks and higher levels in the vicinity, but still more must be obtained elsewhere. The cost of moving the soil and making the fill should be about $1,250. About $100 should be allotted to clearing off the weeds and bushes that will obstruct the ditching and filling operations."

In this way a comprehensive plan of operations and a fairly accurate estimate of the cost of the initial work necessary for mosquito control in a specified locality can be prepared.

Obtaining Funds.

After reasonably accurate plans and estimates are in hand the problem of obtaining funds must be solved. It is safe to assume that if the work has been carried to the stage of completed plans and estimates some one person or some group of persons possessed of a considerable amount of energy and initiative is deeply interested in the success of the movement. If the mover coincides with the person or group who must furnish the means, this problem is extremely simple, but, if on the other hand, the funds must come from a group of large size or from the general public its solution becomes more difficult.

Two ways of getting funds are then open. The person or persons interested may go about among the landowners and residents of the afflicted districts and

attempt to persuade them that the work is sufficiently important to merit their financial support. The person or persons interested may, through the medium of lectures, newspaper and magazine articles, educate the public to a point where the desired work may be paid for from the public treasury. In any case, the danger and discomfort of present conditions must be constantly contrasted with the safety and comfort of the time when the desired work has been completed.

Execution of the Plans.

When the moneys have been secured the organization necessary to carry out the initial work must be formed. Perhaps the simplest form of organization is the employment of a competent engineer who may be held responsible for the proper prosecution of the work by contractors. Certainly, such a method will not leave the active agent burdened with a supply of tools and useless machinery.

Maintenance, Temporary Elimination, and Improvement.

When initial work has been completed it must be maintained. Breeding, which occurs in the thousands of shallow pools of various sorts which after heavy rains are found in depressions of the ground and in old receptacles and in places of permanent character such as sewer basins, cesspools, cisterns, etc., must be destroyed before the adult mosquitoes can be produced.

As the work proceeds, many additions to the drainage systems already installed or entirely new plans for districts that may have been overlooked will seem advisable. Provision should be made to meet such conditions.

When trying to meet the problems of maintenance, temporary elimination, and improvement of anti-mosquito work over a large area, some methods of testing the value of such work must be devised. Many men will be employed and more or less efficiently supervised. Data on effectiveness as measured in terms of mosquitoes on the wing must be had. The practice of the regular collections of adults as described earlier in this paper will afford the needed facts. After a certain amount of experience the person in charge of collections will be able to say, under given conditions of temperature, moisture and wind, just how many mosquitoes per selected unit of time mean that the householder living near the point of collection will be troubled. Fortunately, he can usually discover the dangerous increase in time to find the unchecked breeding and head off the trouble.

The local director of the anti-mosquito work is able, by examining his map of collections, to see at once where the dangerous increases are, and by making a thorough re-inspection at these points, to discover the inefficiency of his maintenance and temporary elimination, and to determine the nature of improvement needed. Of course his map may also show an invasion. It will then become necessary to trace it to its source and take measures to correct the conditions which have given rise to it.

Giving the Anti-mosquito Work a Permanent Character.

After the work of mosquito control has been started and carried forward for several seasons, the problem of insuring the continuance of necessary maintenance and improvement must be solved. The first year of successful work will ordinarily bring about such a gratifying reduction in mosquito trouble, or disease carried by mosquitoes, or both, that the work will stand very high in the opinion of the people

within the protected districts. This public approval will continue for two or three or even more years, and the occasional appearance of a troublesome number will be discounted.

But as time passes the remembrance of the suffering experienced before any work was done will fade, and the appearance of the occasional outbreaks will be charged to inefficient work on the part of the mosquito control organization, and the appropriations necessary for the support of the work may be discontinued. The public will demand that freedom each year become noticeably greater. Of course, this natural change of public opinion may be delayed by educational work in the course of which the nature of the problem is explained. But sooner or later the public will demand that even this occasional trouble, this apparently irreduceable minimum, be eliminated.

Without doubt methods not now in use must be developed if this demand is met. A more fundamental study of the mosquito's natural history must be made in the hope that a clue to the accomplishment of further reductions may be found. The chemotactic responses of this insect are practically unknown. The development of larvicidal agents has only begun. There is much room for that type of research which will develop new and better methods of getting at the problem of mosquito control.

Evaluation of the Results of Mosquito Control.

The last phase of the problem of mosquito control is the evaluation of the results of anti-mosquito work. In dealing with the species which disseminate well known and definitely diagnosed diseases this phase seems to offer little difficulty. Before the work is done a survey of the number of well authenticated cases of disease should be made. Each year after the work the survey is repeated and the conditions before and after compared. This is well illustrated in the work at Princeton, where in 1914 before the work of control began there were 127 cases of malaria, while in 1915, after the work had made a good start, there were 65 cases, and in 1916, after the large part of the work had been done, there were 8 cases. Still more striking results were presented by Dr. Carter last winter. At Roanoke Rapids, North Carolina, in several mill villages of over 4,000 total population, anti-mosquito work reduced the physicians' calls from 50 per day to 2½ per day the first year, and to one call for each three days the second. At Wilson, Virginia, in 1915, every house visited by Dr. Carter had at least one inmate sick with malaria. The five deaths which occurred in August may be taken to indicate that there were about 500 cases in the place. In the summer season following efficient anti-mosquito work there was only one case.

Thus far the only ways of measuring the value of anti-mosquito work when only the comfort of the people is served, are public approval as voiced by the newspapers and governing bodies, and the advancement in valuation of property for taxing purposes.

The first usually appears in a form similar to the following taken from the Newark *Evening Star* on August 16, 1912:

> "That the work of mosquito extermination in Essex County this season has been well done, nobody can doubt or deny. The pest was not entirely destroyed, but that was not expected. The mosquito extermination Act has been amply justified by results and its repeal by the legislature at the demand of some parsimonious county that is willing to suffer the pest rather than pay the small price for getting rid of it is impossible."

Or in a form similar to the following communication from the Paterson *Press-Guardian.*

"*To the Editor of the Press-Guardian:* Sir,—Now that the Mosquito Commission has announced that its operations for this season are ended, it would seem to be a proper time to call attention to the great success of its operation. I have lived in Paterson more than forty years and in my recollection we have never had so much freedom from mosquitoes as during the past season, and this in spite of the fact that the conditions for breeding mosquitoes early this season were ideal. The result, I believe, can only in fairness be attributed to the mosquito extermination work.

"When this work was inaugurated a few years ago, many people were doubtful of the result and seemed to feel that money appropriated for the mosquito extermination work would be money wasted: but it seems to me that any unprejudiced person comparing conditions during the past summer with previous years must realize that the nuisance has been reduced to a minimum and that the money invested in this work has been well spent.

"Let us give due credit to David Young as well as to the members of the Commission and others engaged in the work who have given the matter time and study and hard work, and when the Commission applies for its next appropriation let it have the money without hesitation. Not only does this work promote the comfort of the residents of Paterson but, if continued, it must enhance real estate values, which have suffered in the past from the widespread and free advertising received by the 'Jersey Mosquito.'

"Paterson, Oct. 10, 1917."

While this sort of approval is necessary it is a rather poor yardstick by which to measure the value of permanent work.

Unfortunately increases in real estate values are dependent upon so many factors that one finds it extremely difficult to separate the effect of mosquito control from the operation of other factors. We can, however, say that the development when it is a matter of building up high-class residence districts will not occur where the country is infested by hordes of mosquitoes. A calculation prepared in 1912 shows that the taxable values of shore properties from Jersey City to Sea Bright had increased since mosquito work had begun at least 6½ millions, and that the increase ranged from about 15 per cent. in the manufacturing districts to 300 per cent. in some of the residence districts.

If we may assume that a reasonable freedom from the mosquito pest is prerequisite to large industrial development, and the writer believes that the assumption is in most cases susceptible of proof, an examination of the increase in taxable values on the Newark meadows, which were formerly as badly mosquito infested as any part of the State of New Jersey, will serve as an instance to show the development which anti-mosquito work has made possible.

The meadow comprises about 4,000 acres. Anti-mosquito work began many years ago, became intensive in 1912, and has continued until the present. The taxable value of those marshes and the tax from them are shown in the following table:

Year.	Taxable Value.	The Tax Increase.
1913	$1,735,000	$19,656
1914	2,192,000	22,064
1915	2,251,000	30,390
1916	3,750,000	64,155

In 1912 the tax was $19,656 and in 1916 it was $64,155, making an increase of $44,499, or over 300 per cent. In 1912, 286 men were employed in factories on these meadows with a yearly wage of $152,000. In 1916, 6,341 men were employed with a payroll of $2,863,000.

In dealing with salt marshes, as a by-product of the drainage necessary for mosquito control, we find a decided increase in the annual yield of salt hay. The

undrained marsh yields an average of about .7 of a ton of coarse hay, which hardly repays the cost of cutting and marketing, while the drained marsh produces 2.6 tons of a much better grade, involving an increase of about $15 an acre. It should, of course, be recognized that an average of about three years is required to realize the full benefit.

Conclusions.

Present methods of mosquito control are sufficiently effective to afford much relief from the mosquito pest by freeing protected communities to a very large extent from mosquito annoyance and mosquito-carried diseases. Such results can be obtained only when the matter is gone about in a careful systematic manner, involving a thorough study of the nature of the problem and the creation of an effective organization to carry out the work.

Mosquito control work, because of the large amount of temporary control involved, must become a permanent fixture.

With present methods of control the protected territory will at times be troubled by some mosquitoes, because the enormous increase in breeding surface, brought about by a prolonged rainy period, may be such as the organization cannot cope with.

More thorough or fundamental studies of the life economy of the economic species of mosquitoes are needed in order that still more effective methods of control may be found.

Mr. Gibson: May I ask whether you have used oil to any great extent on the marshy areas?

Dr. Headlee. Oil is used extensively for temporary elimination in small temporary pools, basins, in the treatment of garbage dumps, and to some extent, although only a minor extent, on the salt marsh. It is considered a method of temporary elimination only, and its use is no more extensive than we can avoid. We use a good many thousand barrels of oil in a year, because there is much temporary work to be done, and I think if we take into consideration existing conditions there always will be temporary work to be done. There are always temporary pools under exceedingly rainy conditions, and these pools are breeding grounds for the mosquitoes. We have had the question raised frequently as to why we do not reduce the seed or eggs so that under these extra rainy conditions they could not produce so many insects. We have not got the eggs down far enough yet to notice much difference, although we have made a number of experiments.

Prof. Caesar: What type of oil do you use now?

Dr. Headlee: All kinds of fuel oil. Recently the Standard and other concerns have been making us an oil up to heat strength by putting in a good amount of crude kerosene. We need an oil with a large amount of spread in proportion to holding power, and we are continuously trying all kinds of oil, for until we test it out we do not know the character of it and whether or not it will suit our purpose. The number of fuel oils is tremendous, and the only way we can get the kind we want is to have samples submitted to us and test them for spread and for staying qualities. Some oils will stay for two weeks, and others for two days, some will spread out nicely by themselves, others will have to be sprayed on to make them spread at all. The whole question is a difficult one, and we have tried to get satisfaction from the standpoint of viscosity, but the oil people do not seem able to give us just what we are looking

for. In testing a sample of fuel oil we want one that will spread readily, will make a nice complete coating on the water, and will stay at least a week. But even at the best, oil is only a temporary measure.

A hearty vote of thanks, moved by Prof. Caesar and seconded by Prof. Lochhead, was extended to the speaker in appreciation of his lecture.

Mr. A. F. Winn then delivered the President's Address on "The Bladder-scales of Lycænidæ."

After the evening session, a smoker was held in the Men's Residence, when an extensive discussion on "Canadian Entomologists and the War" took place. The discussion was taken part in by Prof. Lochhead, Mr. Winn, Dr. Headlee, Prof. Burgess, Prof. O'Kane, Prof. Caesar, Prof. Brittain, Mr. Gibson, Mr. Petch and others.

FRIDAY MORNING, 9 O'CLOCK.

After a short business meeting at which the officers for the ensuing year were elected, Prof. Caesar, the newly appointed President, took the chair and in a few words expressed his thanks and appreciation of the honor done him.

Mr. Winn extended an invitation to members and visitors to visit the Lyman Entomological room at McGill University.

THE BLACK CHERRY APHIS.

William A. Ross, Dominion Entomological Laboratory, Vineland Station.

The experiments on which the following paper is based were carried on this past season at the Dominion Entomological Laboratory, Vineland Station, Ontario. The aphis was studied both in the insectary and in the orchard. In the insectary (a covered bench, situated out-of-doors) the plant lice were reared on small sweet cherry trees and Lepidium plants grown in flower pots.

As we have not had time to prepare technical descriptions of the various forms, only popular descriptions are included in this paper.

History.

The black cherry aphis has long been known in Europe and North America as a pest of cherry trees. On this side of the Atlantic the species was first recorded in 1851 by Fitch (Cat. Homopt. N.Y. 65, 1851). The same author in a later publication (Rep. Ins. N.Y. 1, 125, 1855) describes the insect and gives an interesting account of its habits. He suggests that it was introduced into America with the tree which it infests. What is probably the first reference to *M. cerasi* in Canadian literature is contained in Fletcher's Report of the Entomologist, 1885. Mention is merely made of the occurrence of aphids on young cherry trees at Victoria V. I.—no name or description is given. In the Entomologist's Report for 1897, Dr. Fletcher gives the following interesting observations made by Mr. Martin Burrell, at that time of St. Catharines, Ont.:—

"The principal damage has been done by the Cherry Aphis (*Myzus cerasi* Fab.), whose attacks on the sweet cherry of this Peninsula (Niagara) were simply disastrous. I do not think I should be overshooting the mark if I said that half of the crop was ruined. I saw many cases where not only the foliage was covered but even the fruit, and especially the stalks, with lice."

Habits and Depredations.

The cherry aphis is primarily a pest of the sweet cherry. It occurs on, but so far as we are aware, is never destructive to, the sour cherry.*

The aphis feeds on the buds and tender foliage and it may even attack the blossoms and fruit, especially the stems. Infested leaves become tightly curled and when badly attacked turn brown and die. Fitch speaks of aphis-infested leaves "looking as though they had been scorched by fire." The fruit may also be seriously damaged. During the summer of 1915, there was an outbreak

Cherry Aphids on underside of sweet cherry leaf, natural size.

of cherry aphis in the Niagara district and in a Vineland orchard the fruit was so badly injured that most of it was left on the trees. The cherries were small, ripened irregularly and many of them were covered with honey-dew and the black honey-dew fungus.

Migration of M. cerasi.

A difference of opinion has existed among entomologists as to whether this species is migratory or not. Crosby (1) considers that the question is unsettled. Sanderson (2) and O'Kane (3) say that so far as known the cherry aphis has

*Since writing the above, Mr. P. J. Parrott, Geneva Agricultural Experiment Station, has kindly placed at my disposal the following note from Mr. H. W. Lasher, of Wolcott: "Replying to your inquiry *re* the black cherry aphids, I find that some years they do infest the sour cherry. They have attacked in my case, Montmorency, Morello, and Richmond trees. They do not take a block but trees scattered throughout an orchard. They destroy all the fruit, it falling off when the size of a pea."

only one food plant. Gillette (4) states definitely that *M. cerasi* lacks the alternating food habit. On the other hand, Quaintance and Baker (5) claim that it is migratory. How are we to account for these apparently conflicting statements? Is it possible that the species is partially monophagous and partially migratory? Our observations and experiments prove that it is. Apterous forms reside throughout the season on the primary host-cherry, and in addition alatæ, produced during the summer, migrate to and establish colonies on a secondary host.

The cherry aphis apparently has an unique life cycle. Some plant lice with the alternating food habit, e.g., *Eriosoma lanigera, Prociphilus tessellata* and *Myzus persicæ* occur at all times of the year on their *secondary* hosts, but, so far as we are aware, no migratory aphid other than *M. cerasi* normally resides on the primary host all year. If we were given to theorizing, we would suggest that at the present time, the black cherry aphis is in the transitional stage between the migratory type (e.g., *A. avenæ*) and the more specialized monophagous type (e.g., *A. pomi*).

Migratory Tests.

In order to discover the secondary host a series of migratory experiments were made with common plants belonging to the following genera: *Agropyron, Dactylis, Poa, Polygonum, Rumex, Chenopodium, Amaranthus, Stellaria, Silene, Ranunculus, Erysimum, Capsella, Lepidium, Brassica, Lobularia, Potentilla. Prunus, Trifolium, Vicia, Medicago, Malva, Nepeta, Stachys, Verbascum, Plantago, Cirsium, Arctium, Hieracium, Lactuca, Senecio, Ambrosia, Aster, Sonchus, Solidago.* The migrants fed to some extent on cherry, *Polygonum persicaria. Chenopodium album, Rumex acetosella, Stellaria media and Malva rotundifolia.* but did not reproduce on these plants. Young were deposited on *Polygonum aviculare, Rumex crispus, Lobularia maritima, Verbascum thapsus, Plantago lanceolata, P. major* and *Solidago* sp., but they did not grow and soon succumbed. Weak colonies developed on *Brassica arvensis, Erysimum cheiranthoides* and *Capsella bursa-pastoris.** On *Lepidium apetalum* strong colonies were readily established and were carried through to the end of the season.

Field Observations.

In the field our search for migrants was rewarded by finding them and their progeny on wild peppergrass, *L. apetalum* growing within two hundred yards of an infested cherry orchard (first collection was made on July 9th, 1917). The aphis was not taken on any other plant but in spite of this we are strongly inclined to believe that other crucifers besides *Lepidium* serve as secondary hosts. Next season, we hope to be able to prove this.

The Egg.

The minute, oval-shaped eggs (.68 mm. x .32 mm.) change within a few days after being laid from watery green to black. They are deposited around the buds and on the rough bark of twigs and branches. They commence to hatch early in spring when the buds are swelling. In the cherry orchard (situated on the lake shore) which we had under observation this past season, the period of hatching extended from the 17th to the 24th of April. All the eggs hatched at least nineteen days before the cherry buds actually burst.

*One colony on *Erysimum* survived until autumn, at which time it gave rise to return migrants and males.

The Stem Mother.

The newly hatched, dark green stem mothers migrate to and settle on the buds, where they feed on the green tissue. Later on, they attack the tender leaves and blossom buds. After moulting four times, they reach maturity in four or five weeks and commence within a day or two to give birth to living young. The first young are produced about the time the most advanced blossoms open.

Description. The adult stem mother is a glossy black, globose insect, about 2.07 mm. x 1.44 mm., with 5-jointed antennæ.

Breeding Experiments.

In our insectary experiments with 15 individuals the following data were obtained:—

Number of instars: Five.*

Length of Nymphal Life: Maximum 37 days, minimum 30 days, average 31.8 days.

Age when reproduction commenced: Maximum 37 days, minimum 30 days, average, 32.6 days.

Reproductive period: Maximum 41 days, minimum 26 days, average 32.9 days.

Fecundity: Greatest number 198 young per insect, smallest number 80 young, average number 154.9 young.

Daily production of young per female: Maximum 18 young, minimum 1 young, average 4.8 young.

Total length of life: Maximum 85 days, minimum 57 days, average 69.5 days.

Summer Forms on Cherry.

The progeny of the stem mothers develop into apterous viviparous females. This generation is then followed by brood after brood of wingless and winged aphids. The apterous forms remain on cherry and may be found on this tree from spring till late autumn. The alatæ on the other hand leave the cherry and migrate to Lepidium.

Apterous Vivipara.

During the early part of the season wingless forms are very common but as the summer wears along they diminish in numbers. This decrease is due to the production of alatæ, to the effective work of predaceous enemies and also to the drying up of the affected foliage. Moderately infested trees are liable to support more apterous lines throughout the season than are heavily infested ones. In fact, on badly attacked cherry trees the aphids may wholly disappear by mid-summer. For example, in 1915, in a seriously infested orchard at Vineland, no plant lice were found on the trees after mid-August.

Description. The adult wingless vivipara like the stem mother is globose and glossy black. Unlike the latter, however, it possesses 6-jointed antennæ. In size, it is about 2.16 mm. x 1.17 mm.

*In order to avoid repetition I might mention here that all the other forms have five instars.

TABLE No. 1—APTEROUS VIVIPARÆ—M. CERASI.

Generation.	No of individuals.	Length of Nymphal Life.			Age when reproduction commenced.			Reproductive Period.			Fecundity per insect.			No. young per day per insect.			Longevity.			Mean Temperatures.*	Dates.*
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.		
2nd	14	20	14	17.5	20	15	18	28	5	23	184	37	143	18	1	6.2	53	25	44.6	54.6	18/5- 9/6
3rd........	5	14	12	13.2	14	12	13.2	27	12	20.4	156	62	107.4	14	1	5.3	44	25	35.8	61	5/6-19/6
4th........	5	11	8	9.6	12	9	10	24	20	21.8	118	97	105.6	11	1	4.8	41	30	36	63	19/6-30/6
5th........	5	12	10	10.6	12	10	11	24	11	17.6	120	46	88.4	16	1	5	35	23	29.2	63.7	28/6-11/7
6th........	5	10	9	9.2	10	9	9.4	24	12	18.6	88	48	67.4	14	1	3.6	38	22	30	68	9/7-21/7
7th........	5	8	7	7.4	9	7	7.8	26	4	18.6	113	19	74	14	1	3.9	35	11	26.6	78.4	18/7- 1/8
8th........	5	8	6	6.6	9	6	7.2	30	14	22.8	93	44	73.8	11	1	3.2	40	22	31	74.1	26/7-12/8
9th........	5	9	6	7.2	10	6	7.6	27	4	18.4	93	16	60.8	9	1	3.3	39	11	27.2	70.9	1/8-20/8
10th........	5	9	7	7.8	10	8	8.4	37	19	28.8	127	51	93.4	10	1	3.2	47	29	38	69.1	8/8-27/8
11th........	5	12	7	8.6	13	7	9	32	24	27.8	106	42	65.6	7	1	2.4	61	39	49.2	66.7	16/8-4/9
12th........	4	16	10	13.5	16	10	14	43	32	37.5	96	27	62.3	9	1	1.7	72	57	63.8	60.5	24/8-19/9
Last Born Series.																					
2nd L	14	12	9	10.7	13	9	11.1	26	13	18.7	140	65	91.2	13	1	5	43	25	30.8	63.1	13/6- 9/7
3rd...... L	14	11	6	8	13	6	8.6	25	12	18.5	101	46	73	13	1	3.9	40	18	27	72.1	5/7- 1/8
4th...... L	13	12	6	7.9	13	6	8.6	36	10	22.6	117	18	76.3	9	1	3.3	61	19	37.2	70	24/7- 6/9
5th...... L	7	22	8	13.6	22	8	14.6	34	11	19.6	95	20	47.3	8	1	2.4	85	23	43	56.4	20/8-20/10

* During nymphal development.

Breeding Experiments.

In this form, the duration of nymphal life varies very considerably due in a large measure to the great differences in temperature to which the females born early in spring and those born during the summer are subjected. (See table No. 1.) In our experiments the average nymphal life in the second generation was 17.5 days, in the eighth it was 6.6 days.

In the matter of reproductive capacity, this form is slightly less prolific than the stem mother (see table No. 1). One hundred and eleven apterous forms produced an average of 80.9 young per insect.

Summer Migrant.

Migrants are produced on cherry trees during a period extending from mid-June to the middle or latter part of August.* The vast majority of them, however, develop and migrate before mid-July.

Description: The head, thorax, cornicles, and cauda of the migrant are black and the abdomen varies in colour from dark or black green to dark brown. It is about 2.16 mm. long.

Factors Which Produce Alatæ.

A question which should be touched on here is: what agencies tend to produce winged-forms? We are inclined to believe that three of them are, the influence of over-population, the instinct to migrate, and, to a small extent at least, the influence of generation.

With a monophagous species such as *Aphis pomi* the appearance of alatæ is apparently due in a large measure to overcrowding. This hypothesis explains why, by preventing crowding, it is possible to rear apterous lines of the green apple aphis through from egg to egg. With a migratory species, however, such as *Aphis avenæ,* another factor comes into play, viz.: the instinct to migrate. In some of our experiments with the oat aphis one individual was reared on each host plant (apple), but in spite of this superabundance of food and space, all the lines gave rise to migrants—the aphis in order to complete its life cycle had to migrate.

And now to return to the cherry aphis, this louse behaves more like a monophagous than a migratory species. The migratory instinct appears to be attenuated and seemingly is of little or no importance in the production of winged forms. In our insectary work, it was observed that alatæ did not develop unless the plant lice were excessively crowded.

The influence of generation as a minor factor is suggested by the fact that no winged forms occur in the 2nd generation of *M. cerasi*—at least we did not obtain any.

Breeding Experiments.

In our experiments with a large number of migrants the following data were obtained:—

Duration of nymphal life. Migrants took from 7 to 13 days to reach maturity, or in other words, one to four days longer than contemporary apterous viviparæ.

Reproduction: Migrants gave birth to young one or two days after they were transferred to Lepidium.

*A few migrants were taken on cherry on August 27th, 1917.

Reproductive period: Maximum 26 days, minimum 2 days, average 11.6.

Fecundity: The average reproductive capacity of 18 individuals was 16.7 young per insect, the maximum and minimum being respectively 37 young and 4 young.

Daily production of young: Maximum 8, minimum 1, average 1.7.

Total length of life: Maximum 56 days, minimum 4 days, average 15.4 days.

Secondary Apterous Vivipara.

The progeny of the cherry to *Lepidium* migrants develop into wingless viviparæ and are followed by brood after brood of their kind until fall at which time return migrants and males are produced, concerning which more will be said later. For want of a better name, the wingless forms on *Lepidium* are referred to in this paper as secondary apterous viviparæ.

Description. This form is much smaller and is lighter in colour than its fellow on cherry. It is dull brown in colour and is about 1.26 mm. x. .68 mm. in size.

Breeding Experiments.

In experiments with 37 apterous forms the following data were obtained.

Length of Nymphal Life: Maximum 19 days, minimum 6 days, average 9.8 days.

Age when reproduction commenced: Maximum 19 days, minimum 6 days, average 10.2 days.

Reproductive period: Maximum 44 days, minimum 9 days, average 24.5 days.

Reproductive capacity per female: Maximum 83 young, minimum 19 young, average 44 young.

Daily production of young per female: Maximum 7 young, minimium 1 young, average 1.8 young.

Total length of life: Maximum 75 days, minimum 17 days, average 40.8 days.

The Alate Sexupara.

In early autumn migrant aphids* are produced on Lepidium and return to the cherry where they deposit the egg-laying females. At the same time the monophagous lines on cherry give rise to large numbers of winged forms† which also give birth to egg-laying females. In other words the sexupara—the mother of the sexual female—is produced on both the secondary and primary hosts.

Description. This form is very similar in appearance to the summer migrant.

Breeding Experiments.

The data obtained from the sexuparæ bred on cherry (primary host) and on *Lepidium* (secondary host) are presented herewith in tabular form.

*Return migrants were found on *Lepidium* from Sept. 17th to October 29th.

†*Sexuparæ* were produced on cherry from Sept. 9th to the close of the season.

TABLE No. 2—SEXUPARÆ—M. CERASI.

Host.	No. of Individuals.	Length of Nymphal Life.			Reproductive Period.			Fecundity per Insect.			Daily Production of Young per Insect.			Longevity.		
		Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.	Max.	Min.	Aver.
Primary (Cherry)....	13	44	14	20.3	11	2	6	11	2	7	6	1	1.2	61	19	47.1
Secondary (Lepidium)..	6	19	14	16.3	5	2	3.2	6	3	5	4	1	1.6	70	24	52.3

THE MALE.

Early in October winged males* appear on the secondary host and fly back to the cherry where they mate with the oviparous females. No males are produced on cherry. This means that, in spite of the pronounced tendency of the black cherry aphis to live a monophagous life on cherry, the completion of its life cycle is still dependent on the existence of a secondary host.

DESCRIPTION. Antennæ, head, thorax, cornicles and external genitals black. Abdomen reddish brown with dark transverse bars, and three black lateral spots. Length 1.53 mm. to 1.62 mm.

NYMPHAL LIFE.

The average duration of nymphal life of 29 individuals was 35 days, the maximum and minimum being respectively 25 and 44 days.

THE OVIPARA.

This form may be found on the leaves, twigs and branches up to the time all the aphids are killed by frost.

DESCRIPTION. The general colour of the ovipara is dark brown. The abdomen may be tinged with green. In size, it is about 1.8 mm. x .8 mm.

BREEDING EXPERIMENTS.

In our experiments with 13 individuals the following data were obtained:—

Length of Nymphal Life: Maximum 33 days, minimum 21 days, average 27.4 days.

Age when egg-laying commenced: Maximum 53 days, minimum 26 days, average 40.2 days.

Reproductive period: Maximum 22 days, minimum 1 day, average 10.2 days.

Fecundity per female: Maximum 8 eggs, minimum 1 egg, average 1.2 eggs.

Longevity: Maximum 71 days, minimum 52 days, average 61.6 days.

NUMBER OF GENERATIONS.

According to our experiments there are from six to fourteen generations of this insect per year in the Niagara district.

*Males developed on *Lepidium* from October 6th to November 17th.

Natural Control.

Insect Enemies.

Like most species of plant lice the cherry aphis is harassed by many insect enemies. Amongst these enemies are numbered the following:—

Coccinellidæ—*Adalia bipunctata* Linn. (Apparently the most important predator), *Coccinella 9-notata* Herbst., *C. transversoguttata* Fabr., *C. trifasciata*. Linn., *C. sanguinea* Linn., *Anatis 15-punctata* Oliv., *Hippodamia 13-punctata* and *Scymnus collaris*.

Syrphidæ—*Syrphus americanus* Wiedemann, *S. ribesii* Linn., *Allograpta obliqua* Say.

Cecidomyiidæ—*Aphidoletes meridionalis* Felt.

Chrysopidæ—*Chrysopa* sp. (No lace-wing flies were reared).

Acarina—An undetermined, bright, orange red species.

Weather Agencies.

Undoubtedly the most effective weapons employed by Nature in checking the multiplication of this, and other species of plant lice are weather agencies. Heavy rains wash off large numbers of aphids, especially in spring before the pseudogalls are formed. Droughts are frequently disastrous to the lice, chiefly, we think, because such weather deprives the host plants of succulency. Early frosts and wind storms also may destroy countless numbers of immature sexual females by causing the foliage to drop prematurely.

Artificial Control.

The cherry aphis is most vulnerable early in spring just before the buds break. At this time all the eggs have hatched and the young stem mothers, feeding on the buds, are absolutely without protection. Thorough spraying at this stage with a good aphidicide will destroy all or practically all the lice.

Last spring, we tested this remedial measure in a Vineland orchard. One-half of the orchard—the check—was given the usual treatment with lime sulphur. In the other half, lime sulphur combined with Black Leaf 40 (¾ pint to 80 gallons) was used and the application was not made until shortly before the buds burst. Because of the slow multiplication of the lice on the check trees, due to unfavorable meteorological conditions, the results obtained from this experiment did not show up to advantage until early July. At that time, the following notes were made:—

"Examined all the trees sprayed with Black Leaf 40 and found only one small colony. In the check block all the trees are more or less infested and some are badly attacked. By noting the condition of the foliage—normal or curled—it is a simple matter to tell where the treated rows end and the unsprayed section begins."

Literature Cited.

(1) Slingerland and Crosby:
Manual of Fruit Insects, p. 312.

(2) Sanderson, E. D.:
Insect Pests of Farm, Garden and Orchard, p. 666.

(3) O'Kane, W. C.:
Injurious Insects, p. 318.

(4) Gillette, C. P.:
The Monthly Bulletin of State Commission of Horticulture, California, Vol. VI, No. 2, p. 63.

(5) Quaintance and Baker:
Farmers' Bulletin 804, U.S. Dept. of Agr., p. 24.

Father Leopold: Is it a fact that there is no male on cherry?

Mr. Ross: The male is produced only on the secondary host.

Dr. Headlee: We found with apple aphis that there was a peculiarly susceptible stage in the egg just before hatching. The egg has three layers, one of which is a transparent layer, and this layer splits about a week before hatching. The egg is then very susceptible to light, moisture and other influences, and to chemical sprays, etc., and I wonder if Mr. Ross has found a similar condition in the eggs of the Black Cherry Aphis?

Mr. Ross: No. I have not found this with Black Cherry Aphis, but I have with Apple Aphids. We fumigated trees that were heavily stocked with the eggs of the Oat Aphis and *Aphis pomi* about ten days before the buds burst. We destroyed one hundred per cent. of the eggs with hydrocyanic acid gas, 1 oz. to 100 cubic feet, but we have not done anything with the Cherry Aphis.

Dr. Headlee: Have you experimented with chemicals on the eggs?

Mr. Ross: No.

Dr. Headlee: We found that carbolic acid was effective in dealing with the apple aphis egg at this stage.

Prof. Caesar: Was this a laboratory experiment or an orchard experiment?

Dr. Headlee: Both.

Prof. Caesar: Dr. Headlee gives us another suggestion, and that is what most workers are seeking for. From my own observations it would appear that lime-sulphur wash seems to have quite an effect during some seasons, and in other seasons it has almost no effect, or a very slight effect.

Dr. Headlee: The addition of Black Leaf 40 seems to increase the killing effect of lime-sulphur on the egg. I think Parrott and Hodgkiss had some success with this.

A COMEDY OF ERRORS.

Francis J. A. Morris, Peterborough.

It is surely astonishing how often the two Dromios have made their appearance on the entomological stage. These amusing little comedians seem never to pall, and their simple farce, trite as it is, continues—like a Punch and Judy show, or the Marks Bros.—to draw crowded houses and evoke peals of delighted applause. It speaks well for the wholesomeness of our hobby that the entire brotherhood of us should remain so perennially gullible, so good-humoured over mistakes, and so easy of diversion. Masquerading must be as old as the hills, and mistaken identity forms one of the leading motives in the world's literature. It is found in the oldest sagas. Aristotle remarks how effectively Homer uses it in the Odyssey; and still to this day it remains one of the great well-springs of Romance; now sparkling in the lightest of comedies, now darkening the unplumbed gulfs of tragic depth.

All enthusiasts are apt to be uncritical, and collectors for a variety of reasons are probably more prone to error than most people. Our zeal outruns discretion; in the flush of a fresh capture we are at the mercy of two opposite impulses; we would dearly love our prize to prove something quite new, and we fairly ache to get it placed just where it belongs, with its next-of-kin in our cabinet. Now, an insect being a most intricate complex of diverse features, we are very apt—the wish being father to the thought—to seize on something superficial and strain a point of identity or of difference. How often in this way have two individual insects, created male and female of one species after their kind, been divorced to opposite ends of the collecting case from some purely sexual or even accidental distinction of size, marking, or structure? And the contrary error of confusing types essentially different, augmented even, on occasion, by the distracting presence of mimetic forms, beguiles the unwary just as often; and here it is that the two Dromios get their cue to come in and play the cat and banjo with our cabinet. I remember as a small boy arranging my collection of birds' eggs by similarity of colour-pattern, and under the impression that they were just undersized eggs of the common chaffinch, innocently disposing of some very rare red-poll's eggs to a more mature oologist(an Aberdonian and already one of the shrewdest of Scotchmen).

Henshaw's check-list of North American Coleoptera no doubt teems with synonyms; but on the other hand, if you trace back the history of a standard check-list, from its latest edition to its earliest, you will meet almost as many instances of genuine species that have blushed unseen for generations under a pseudonym; and though some authorities are undoubtedly overfond of multiplying species, there can be little question that the most carefully prepared and up-to-date check-list still contains a few rightful heirs, waiting to come into their own, hidden under the bushel of a synonym. It is the story of one of these neglected claimants that I shall try to tell you here.

When I entered the field of entomology more than twelve years ago, it was by way of a bridle-path from the neighbouring realm of botany. And the natural inclination to make my hobby of wild flowers run in double harness with that of beetles, was given a final set in the very first season of 1905; I went over to Great Britain on a botany trip at the end of June, and formed there the habit of carrying a cyanide bottle out with me on all occasions; whatever I saw in the shape of a beetle on stem, leaf or blossom, I captured, noting its season and habit. It was this somewhat peculiar and restricted form of collecting that soon led me to a number of unusual finds and at last landed me, as a sort of monomaniac, among the Longicorns. Moreover, my running mate in Port Hope, the man whose hobby trotted to the same tune as mine, had several years the start of me in entomology, and it was only by drawing on my capital of plant-lore that I could hope to turn the handicap into a neck-and-neck race.

I well remember how closely I watched in 1906 for every new flower to unfold from early April on through the weeks to August and September. And before May was over I had already made some finds quite new to my companion, whose cabinet specimens had hitherto enabled me to determine nearly all the contents of my cyanide bottle. I can still plainly see in memory the hawthorn on the edge of a certain wood where some of my first surprises occurred. And foremost among these was a dusky grey and black insect so like one of the common large black ants, that it was only after passing it over several times that I noticed the long gracefully-curving antennæ, and hastened to bottle my find. As soon as I got home I communicated this new discovery to my fellow-collector, and he included some specimens in a box of material he was on the point of sending away for identification.

Now the fervor of a new pursuit had prompted me to purchase a copy of what has ever since been a kind of bible to me, LeConte and Horn's Key to the Generic Classification of North American Coleoptera. Pending the return of the box with its inmates labelled, I occupied myself with a lens and the famous key, unlocking the riddles of generic status. After a good deal of trouble I worked down my specimens to the group *Anaglypti*, and once I had done that the rest was plain sailing: the insect had no ivory vittæ and could not be *Euderces;* it had not round eyes, so was not *Tillomorpha;* it must be either *Cyrtophorus* or *Microclytus*. Here the specific name *gazellula* under the latter genus was very tempting, for never had I seen a Longhorn with more graceful outline or more elegantly curving antennæ than this; but there was no room for choice, the fourth antennal joint was more than twice as long as the second, and it simply *had* to be *Cyrtophorus verrucosus*—even though this being interpreted should mean the "lumpy hunch-back," a name more apropriate surely for some African rhinoceros or wart-hog, or for our own American buffalo, than for this dainty little chamois.

Flushed with the pride of my discovery, I ventured to prophesy what name my fellow-collector would find on the label when his box came back. You may imagine how nonplussed I was, when we opened the parcel, to find instead the legend—*Microclytus gazellula*. I was so sure of my identification and so full of faith in my bible of entomology that I had actually the hardihood to write to the curator of the museum explaining my predicament. Almost by return of post came word that our specimen had been identified by comparison with an insect so labelled in a collection to which the Museum had fallen heir; the original owner had wrongly determined it; LeConte and Horn were perfectly correct, and the insect was undoubtedly *Cyrtophorus verrucosus*. So, after all, my trouble had not gone for nothing.

It is obviously impossible in a large collection to verify all the names, unless the institution is fortunate enough to have at its disposal a whole army of expert systematists. But what ever-widening rings of error spread from cabinet to cabinet by this same practice of taking things on trust. No wonder Descartes swore to question everything, even to mathematical axioms, rather than succumb to the tyranny of tradition; the world of thought has indeed good reason to thank God for its sceptics.

This creature captured on hawthorn has long been a great favourite of mine; no doubt partly because it was by pursuing a line of my own that I had made its discovery, and the work had the novelty and fascination of original research. But few who have closely examined this little insect can help admiring the exquisite grace of symmetry and proportion in its outline, the nobly arched dome of the thorax, the bold elevation of the elytral base, balanced by the swelling fullness of form just forward of the terminal declivity; on the whole creature not a single bright tint, nothing startling or bizarre in pattern; the colours very plain and the design of the simplest; almost Quaker-like in the severity of its garb; passing by the gentlest of half-tone gradations from velvety black hood and mantle to skirt of grey-drab, the whole uniform from head to foot broken only by two or three delicately pencilled lines of white, forming a median group of curving diagonals and transverse band between shoulder and waist.

Until midsummer this formed a solitary species in the *Anaglypti* group of the *Clytini;* but throughout July specimens of *Euderces picipes* were captured quite abundantly in a variety of blossoms; this creature, too, is extremely ant-like in appearance and even in movement; moreover, as representing the *Anaglypti* in which ivory vittæ are present, it roused no small interest in us young collectors.

The success of our blossom-hunting experiment made us await the spring of

1907 with great eagerness, and we certainly deserved some reward during the season, for we were very diligent, and must have peered into thousands of floral envelopes in never-tiring search from April to July. There can be no question that it was this extraordinary pertinacity of ours that led to the strange coincidence mentioned in a former paper (Can. Ent. XLI, 12, Dec., 1909). And here the curtain rises on our second act.

On Saturday afternoon, June 15th, 1907, I discovered for the first time how attractive the blossom of spiked maple was to beetles. Spiked maple and dogwood formed a great part of the edge of a swampy piece of wood about one and one-half miles north of Port Hope. On a hot, sultry afternoon such collecting ground proved, as I well remember, a perfect inferno of mosquitoes; but the sight of crowding *Lepturas* never seen before (e.g., *L. vibex*, *L. exigua*, *L. capitata*) was simply irresistible, far harder to withstand than a myriad of mosquitoes.

The following morning my fellow-collector and I had agreed to meet on the railway track not far from this spot and tramp up to our favourite *rendezvous* of the "North Wood," near Quay's Crossing. I determined to set out ahead of time and look over the spiked maple before going further north. While busy bottling a splendid haul of *Gaurotes cyanipennis*, *Encyclops cœruleus*, and *Cyrtophorus verrucosus*—all treasures in those days—I was aware of a small pale-looking specimen of what I took to be this last on a blossom of spiked maple. I can still see it, nestling in the bloom as my fingers approached it, and I well remember wondering whether this diminutive specimen had faded or was merely disguised miller-like for the nonce in a dusty coat of yellow-grey pollen. When I joined my friend we went north and visited (among other things) the hawthorn that had proved so lucky the season before. We both made captures on this tree; among mine a small species of oak-pruner, and among my friend's—a diminutive *Anaglyptus* that he bottled under the impression he had captured *Cyrtophorus verrucosus*.

Only when we got home, and each in his own privacy came like a modern Ali Baba to pour out his jar of treasure, did we become aware of a stranger in the midst. For my part I hastily turned up LeConte and Horn and almost at once concluded that I must have run to earth either *Tillomorpha* or *Microclytus;* the lens revealed an emarginate eye, so *Tillomorpha* was out of the question. And it was then that things began to happen thick and fast; you must remember that I had never seen *Microclytus*, but the book (my bible) declared the second antennal joint in *Microclytus* almost as long as the fourth, and in my insect, do what I might—by the greatest stretch of imagination, it remained barely half as long (Sc. 1:). Next day, Monday, I hurried down to my companion's and had not more than begun to unfold my tale of a stranger when he capped it with his (Sc. 2:). We were both equally eager to compare the two specimens, and no sooner had I set his insect under the lens and taken a glance at the antennæ, than I knew he had captured what I had not, a genuine specimen of *Microclytus gazellula* (Sc. 3:).

But what was my insect? I decided it must be an undescribed species of *Cyrtophorus*, and there the matter rested till some time after the November meeting of 1909, where I read a paper called "Guests at the Banquet of Blossoms." Mr. Chagnon then very kindly offered to determine my beetle, and it was with quite a flutter of excitement and pleased anticipation that I despatched the little enigma to him. You may partly guess my chagrin when I got word from him that it was the male of *M. gazellula*, and that the female only, it had been discovered, had the peculiar proportion of antennal joints 2-4 as described in LeConte and Horn. I felt, I must confess, very sceptical about this determination, and in 1910 I purchased from New York quite a number of Longicorn beetles for comparison;

among them, single specimens of *Tillomorpha* and *Microclytus*; and certainly when I set this last and my capture side by side, I could not help wondering whether anybody had really ever taken a pair of *M. gazellula* in the act of mating. And here the curtain falls on Act II of our little drama.

Ignoring the unities of time and space, let us next suppose ourselves transported to Peterborough in the spring of 1916. Gentlemen! the Wood of Desire! On my first trip through this Eldorado in 1915 I had been struck by the resemblance of a certain trough of swampy ground fringed with spiked maple and dogwood, to the corner of Choate's Wood at Port Hope, where this unique little *Anaglyptus* had been taken. It was too late that season for anything but the last spikes of maple blossom; yet, though I found nothing new on them, there were, nevertheless, anthophilous longicorns enough to bring me to the Wood of Desire very early in 1916.

On Victoria Day I made captures of *Pachyta monticola* about white trillium on the west of the wood, and noted a projecting spur of land at this point well covered with sumach thickets, small balsam poplar, elder, dogwood, choke-cherry, pincherry, thimbleberry, bracken, and other growth: a kind of compromise between the forest at its base and the arable country that confronted and flanked it, a no-man's land that I have always found peculiarly attractive, affording as it does to woodland denizens, sunshine, shelter, and food. Though the spiked maple would not be out before the second week of June at the best, choke-cherry and early elder burst at least a fortnight sooner, and things that season had come on with a rush since the hot spell of the middle of May.

Accordingly, about eleven a.m. on the 4th of June, after a tramp of over two hours, I found myself at this collecting groud. It was a hot, sultry day, and soon after noon thunder began to rumble in the west. The only blossom that seemed to be luring insects—indeed almost the only blossom that was fully out at this time—was choke-cherry, and I had been renewing my acquaintance with quite a number of old friends including *Cyrtophorus verrucosus,* when I suddenly spied a specimen of the strange little *Anaglyptus* of 1907 in a cluster of choke-cherry. The shrub on which I captured it was only a few yards from the rail fence that skirted the wood, but there was choke-cherry in abundance running right out to the end of no-man's land. Every cluster on this fateful shrub I carefully scanned: then every cluster on two or three neighbouring shrubs; then a straggling tree of choke-cherry, drawing down its branches one by one and ranging closely over the flower clusters. By this time I had captured five specimens; then I hunted over most of the choke-cherry towards the outer end of the promontory, and drew an absolute blank; then I came back towards the wood on a more northerly line, still unsuccessfully, till I reached the fence on the skirts of the wood proper; here in a large tree of choke-cherry I captured one more (six) ; then I returned to the scene of my first captures and almost immediately took a pair mating, and presently (treading on one another's heels) three singletons. And on the instant the sun was blotted out, the sky grew violet ink and the rumbling threats of distant thunder became a present reality; down came the rain and I fled for the road.

I was soaked long before I got there, but took shelter under a large balm of gilead: while standing there I noticed on the opposite side of the road a small shrub of choke-cherry, which served to feed my spleen during the rest of the storm. Everything was deluged before the thunder passed, and more work in wood or field that day was out of the question: but before setting off on my eight-mile homeward trudge, I stepped sardonically over the way to the draggled little shrub of choke-cherry: and there in its clusters, snug and fairly dry, I found two specimens of *Cyrtophorus verrucosus* and one more of my little enigma. The roads were a

perfect quagmire, my clothes were wringing wet, my boots were sodden and cheeped and slithered at every step; one of the dreariest, most draggle-tailed trips I ever made; and I verily believe I would have been on the road yet, but for what I knew were the contents of my cyanide bottle, twelve genuine specimens of *Anaglyptus enigmaticus* including both sexes of the species.

The rest of the month proved wet and cold; the wood was so distant that it could only be visited at weekends; on my next trip I found the choke-cherry all over, and on the dogwood and viburnum that were rioting in its place I could find no further trace of the beetle. Right on the north margin of the wood, however, on spiked maple, I captured one solitary specimen on June 12th and two on June 18th. Sixteen specimens—counting the unique capture of 1907—made a fine series for comparison. But I found, now, reason to deplore having put my mating pair into the cyanide bottle instead of segregating them. Not that I had a shadow of doubt myself about this being a genuine species; I was absolutely certain of that before I ever saw a pair together; but how could I convince my fellow-collectors? As soon as I got the insects out of the killing-bottle, I examined the antennæ: all fifteen specimens had the second joint less than half the length of the fourth; not one of them, therefore, was the female of *Microclytus gazellula;* equally certain was it they were all one species and comprised both sexes. Some days later I relaxed them all carefully on damp blotting paper in a covered tin box, and with a fine pair of forceps drew the antennæ taut over the back in a straight line parallel with the suture; in eight specimens the antennæ were as long as the body, in eight they just overlapped the median band of pubescence.

I enclosed a pair in a box which I posted to Mr. C. A. Frost, of Framingham, Mass., asking him if these were not the insect Casey had named for him *Microclytus frosti.* Then I sent to Rochester for a micrometer scale and to Guelph for the loan of one or two specimens of *M. gazellula* from the Society's collections, explaining that I wished to make a comparative study. Presently came a letter from Mr. Frost that my insect *was* his insect, and both (he believed) were Dr. LeConte's insect *M. gibbulus.* Next came a parcel from Guelph containing two more specimens of the identical insect I had just captured, both labelled *Microclytus gazellula.* I then wrote to Mr. Frost and to some other collectors in the States for specimens of the genuine *M. gazellula,* but not one of them so far has been able to secure a specimen for me. For several months I advertised in the *Canadian Entomologist* but with a like want of success.

In the autumn of 1916 I got a letter from Mr. Frank Mason, of Philadelphia, to say that the beetle I wanted was extremely rare and that he had only a single specimen; his letter incidentally served to complicate matters by declaring among other things that the insect in question was now listed not as *Microclytus gazellula,* Hald., but as *Anaglyptus compressicollis,* Castenau and Gory; for it at once began to dawn on me that if there were two insects so similar as to have long been mistaken for one another, the problem of nomenclature was likely to be no less complicated than that of my capture's natural status; unless the types of Castenau and Gory's description in the thirties and of Haldeman's description in the fifties had been preserved, no one would ever know which of these two little jokers had sat in either studio for his portrait.

For my part I was drawn rather to the question of the insect's true place in nature, and proceeded to apply, among other things the micrometer scale I had purchased from Bausch and Lomb to a solution of the problem. To supplement the single specimen of *M. gazellula* in my cabinet, I borrowed Dr. Watson's genuine example of 1907 from Port Hope, and then selected several specimens (male and female) of my insect that tallied in size with these two. The examination resulted

in a discovery of no little interest and perhaps some importance. If you refer to LeConte and Horn's classification you will find it stated that *M. gazellula* has the second antennal joint long—fully half as long as the third and nearly as long as the fourth. Now in regard to the relative length of those three joints, this is a perfectly true statement; but the peculiar proportion in this species is due not to the greater length of joint 2, but to the abnormal shortness of joints 3 and 4. The length of the second joint of *Microclytus gazellula*, *Microclytus gibbulus* and *Cyrtophorus verrucosus*, in specimens of the same size and quite irrespective of sex differs not a hair's breadth, i.e., in all three insects it is extremely short. The peculiarity of *M. gazellula* consists in the third joint being only twice (instead of three or four times) and the fourth joint only one-and-a-third times (instead of two or three times) the length of the second point. The mistake is a natural one, almost inevitable; it is due to an optical illusion; the eye passes in all three insects along the third joint, a very long one, to the fourth, a much shorter one; then back to the second, and finding the second in *M. gazellula* almost the length of the fourth, but in *M. gibbulus* and *Cyrtophorus verrucosus* much less than the fourth, judges the second accordingly to be absolutely long or absolutely short.

In *M. gazellula*, then, the second antennal joint is perfectly normal for the group, but joints three and four are abnormally short; and from this follows an important corollary; the remaining joints bear a fixed relation to the first three, and if in *M. gazellula* these basal joints are shorter than in the other members of the group, the whole antenna will be shorter. I have been able to examine only three specimens of *M. gazellula*, and in none of them does the antenna, when drawn taut, exceed the median band of pubescence, while in one large specimen it does not even reach the second diagonal line of pubescence; I feel confident this last is a female and I would venture to prophesy that no specimen of the genuine *M. gazellula* will be found (even male) with antennæ exceeding the median band. In *M. gibbulus*, as I have said, the male antennæ are as long as the body and the female slightly exceed the median band. There are other differences that I could mention between the insects—as in the white marks on the under side, the prevalence of long flying hairs, and the shape of the prothorax—but I should overstep the limits of time and patience.

These micrometer tests were made in the late fall of 1916, and all this time I was so busy planning for the next season's campaign, that during most of the intervening months I went about like one in a dream. You may have thought, perhaps, you met me, or even stopped and spoke with me that winter, but all you really saw was the empty jacket of my body, a "toom tabard" wholly uninformed: heart and soul, I was far away at the Wood of Desire, stalking *Microclytus gibbulus*. In November I bought a bicycle; in April I learned to ride it; in May I got half a hundred pill-boxes and as many gelatine capsules, and, like some itinerant quack gathering samples for his nostrums, proceeded to trundle myself out to the Wood of Desire.

The choke-cherry, like other blossoms, was more than a week late this year, but I managed to get in about three good days' collecting in June while the blossom was at its height, and the results of my campaign in more than one respect will astonish you. Of this obscure little insect I actually captured over seventy specimens in one day, twenty on a single tree, including a mating pair; all this on choke-cherry and before the 15th, but even in the last week of the month I bagged a belated little covey of five, three on dogwood and two on spiked maple; the captures were made at four different points on the wood's edge, over a mile apart between extremes; and the entire catch for the season was upwards of one hundred specimens. Of these I brought home over fifty alive in the solitary confinement of my

little pill-boxes: I then turned the captives loose into a large cardboard box with a slab of glass over the top. In a quarter of an hour I had secured eighteen mating pairs in my insect Agapemone.

While watching the movements of these little beings I found myself curiously reminded of animals we usually reckon far higher in the scale of creation. For I observed the most diminutive male in this assemblage—a perfect Lilliputian—having evidently singled out his mate, make a bee-line for the largest female in sight; and, to complete the analogy, his suit prospered and he presently waltzed away like the hero of Hans Breitmann's party with the Matilda Jane of Brobdingnag. Traces of this same eccentricity of preference, it is whispered, have been found among human beings; nay, specimens have actually been collected by anthropologists and transferred to their cabinets, pinned and labelled "Atavism"; poor hapless freaks of human frailty, caught like Ares and Aphrodite in the meshes of a science as pitiless as the art of Hephæstus, and exposed in all the nakedness and shame of cold print to the inextinguishable laughter of the Olympians and of their fellowmen.

Having now absolute proof of a genuine species, male and female, I proceeded to take up some points that I had left in abeyance last year. Among the letters received while searching for *M. gazellula* I had had a very courteous note from Chas. W. Leng, in which he offered to send me his specimens of the beetle for the comparative study I had been minded to make of these two Dromios. Since that letter of his in 1916 I had found that Mr. Leng was as deeply committed as Dr. Hamilton and Prof. Wickham to the heresy that my capture was the male of LeConte and Horn's *M. gazellula*, Hald. In July last I, therefore, wrote to Mr. Leng suggesting that I should send him five or six specimens (male and female) of my capture for him to compare with the material he had labelled *M. gazellula*.

The evidence of these specimens proved quite convincing, and Mr. Leng has prepared a paper called "Microclytus, a Correction." In the course of it occurs a most interesting passage which records how the confusion first arose. It appears that Mr. Leng had in his collection two specimens from Canada labelled *M. gazellula*, and, when comparing notes sometime in the eighties with Dr. Horn, found in the latter's collection two specimens from New England labelled *M. gazellula*; he then noticed that his insect differed from Dr. Horn's in the proportion of its antennal joints 2-4; the beetles were otherwise so entirely alike that neither collector suspected the presence of two distinct species, and both agreed that the Canadian specimens must be males and the New England ones females of *M. gazellula*, Hald. They thereupon exchanged each of them one specimen with the other! And this was the *fons et origo malorum*; to it may be traced the sinking to a synonym of LeConte's *M. gibbulus* from Lake Superior, and the subsequent identification of all captures made of either insect as *M. gazellula*, Hald., male and female.

In September last I sent some pairs of my capture to Mr. Charles Liebeck, of Philadelphia, and he is still at work on the evidence. Meantime he has made me two communications which serve to support the contention made. *First*, that we have unquestionably two quite distinct species to deal with, and that he has never before seen two insects so essentially different correspond so closely in elytral markings and external appearance; and *second*, that he believes he has put his finger on the very source of the whole error, *for in Dr. Horn's collection he finds the specimens labelled M. gazellula, Hald., male and female, are one of them my insect and the other LeConte and Horn's.* This, fortunately, is quite independent testimony, for Mr. Leng's paper is still unpublished, and I had made no mention of its contents in writing to Philadelphia.

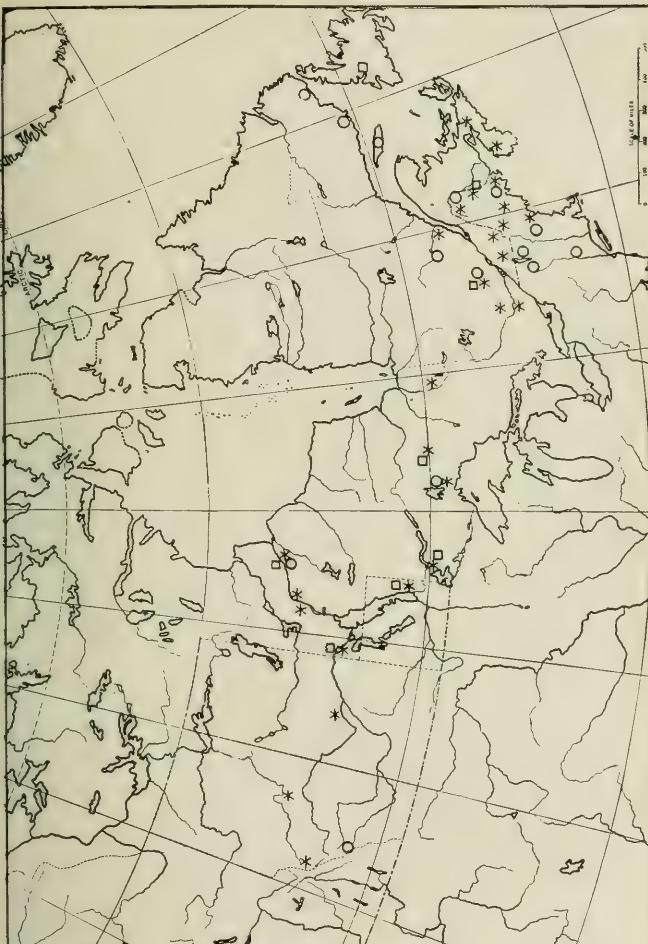
TRANSCANADIAN SPIDERS.

J. H. Emerton, Boston, Mass.

About the year 1890, Mr. J. B. Tyrrell, who was fresh from exploration in the north of Canada, sent me a little collection of spiders. About the same time, Mr. Bean, who kept the telegraph office at the Canadian Pacific Railway Station at Laggan, was collecting insects through the mountains, and incidentally spiders, and he sent me some for identification, so I wrote a paper on Canadian spiders. which was published in 1894 by the Connecticut Academy. Many of these spiders were from the western part of Canada, and nearly all were of species known in the east. but at that time hardly anything was known about their distribution across the continent. Among the species collected by Bean was one since known by the name of *Linyphia nearctica*, which was described in the 1894 paper and not noticed again until fourteen years later, when for the first time I went to the top of Mt. Mansfield, in Vermont, near Lake Champlain, and there found it abundant in the dwarf spruce trees. Going down the mountain it ceased to be found a thousand feet below the summit. Within a few years this species was found on the tops of several of the New England mountains from an elevation of 2.500 feet up to the highest trees. Although I had collected for many years in these mountains, this species had been missed, as my time had been spent either in the valleys or on the top above the trees, neglecting the upper edge of the forest. A few years later *Linyphia nearctica* was found on the coast of Maine. and soon after in bogs, through the northern part of that State, in association with *Theridion zelotypum* which had long been known as far south as Portland and no farther. These two species seemed to have such definite limits, and to be so easily found when they were present, that I was interested in following out their distribution, and so was led to transcanadian spiders in general.

In 1914 I went to the meeting of the Canadian Alpine Club in the Rocky Mountains, and returned east by a roundabout way to see the country north of the Saskatchewan River. In Jasper Park I was surprised to find, in company with distinctly western species, my old acquaintance of down east, *Theridion zelotypum*. living in the small spruce trees in the usual coarse cobwebs and cup-shaped nests. At Athabasca Landing I found it again, and also at Prince Albert. Discussing these finds among my friends led to the discovery of *Theridion zelotypum* by Mr. Waugh, at Nipigon and Manitoulin Island, and *Linyphia nearctica* by Messrs. Townsend and St. John on the southern coast of Labrador. Much of the seasons of 1915 and 1916 was spent in trying to define the southern limits of *Theridion zelotypum* between the White Mountains and the St. Lawrence River. It appears not to go into the White Mountains nor the Adirondacks, but is abundant around the head waters of the Connecticut River and the Rangeley Lakes. In Dixville Notch it is associated with *Linyphia nearctica* at an elevation of 1,800 feet. Westward it occurs at the southern end of Lake Megantic, at Sherbrooke, Montreal, and Ottawa.

Last summer I followed these two spiders along the edge of the Hudson Bay bog, at Cochrane, Minaki and Lake Winnipeg to Le Pas and down the Hudson Bay Railway as far as it is finished. *Theridion zelotypum* was abundant at all these stations and conspicuously absent from the prairie country around Winnipeg and Dauphin; *Linyphia nearctica* only appeared at Kettle Rapids, the most northern station. The spots on the map show the stations of these two species, the *Theridion* in stars and the *Linyphia* in circles, and they form on their southern


ARCTIC

border a fairly definite line by which the distribution of other species can be measured. The squares show the stations of *Linyphia limitanea*. This was first found on the Aroostook River, near the boundary between Maine and New Brunswick, and at the same time in Newfoundland. It follows westward nearly the same distribution as *Theridion zelotypum*, but does not come quite as far south. To avoid complication these three species are the only ones plotted. *Theridion montanum* covers the southern part of the range of *Theridion zelotypum* and extends farther south but not as far north. It goes into the New England mountains, but is not confined to high elevations like *Linyphia nearctica*, but comes down a thousand feet lower into valleys like the Crawford Notch.

All the spiders which have been mentioned make cobwebs and live in trees, preferably in spruce, and with them follow several other tree species of similar habits, but less definite distribution, *Lophocarenum decemoculatum* and *Grammonata pictilis* being the most constant.

On the ground under and near these trees wherever there is an accumulation of leaf mould or moss, other than sphagnum, lives another group of spiders apparently as regular in their distribution. *Theridion sexpunctatum* is one of these and extends from the coast of Maine to Vancouver. With it are *Pedanostethus fusca, Bathyphantes alpina, Tmeticus montanus, Tmeticus armatus, Tmeticus bidentatus, Cryphœca montana* and *Amaurobius borealis*. The recent Canadian Arctic expedition has brought back two minute spiders, *Tmeticus brunneus* and *Microneta crassimanus* from Nome, Alaska, both of which are rarely found in the upper forest of Mt. Washington, N.H.

Beside the spiders living in trees and in the moss there are some species living on the ground that follow the same distribution. *Lycosa albohastata*, a brilliantly coloured hunting spider, lives at Hopedale and Battle Harbor, Labrador, on islands off the coast of Maine, above the trees in the White Mountains, at Kettle Rapids in the Hudson Bay bog, and on Sulphur Mountain at Banff.

The southern limits of the spiders we have been reviewing correspond roughly with the southern limits of the spruce forest area; their northern limits are yet to be defined. Over the whole forest area and north, and to some extent south of it, range several species of *Lycosidæ* from Labrador to the Pacific coast and from Greenland to the mountains of Colorado. The most diffuse of these is perhaps *Pardosa glacialis*. It is found on both sides of Greenland, along the Labrador coast and south as far as Massachusetts, and at various localities across the continent. The recent Arctic expedition brought it from Coronation Gulf and Nome, Alaska, and it is on all the mountains east and west. *Pardosa groenlandica* is almost as widespread. It comes down the east coast as far as Portland, Maine, and is on the Pacific coast and all high mountain tops. *Pardosa luteola* lives in bogs and on mountain tops across the Continent, and *P. uncata* and *P. tachypoda* in all kinds of country, at a little lower level all the way across.

South of the coniferous forest many of the spiders of the plains and hardwood forest extend across the continent, among them several of the large Epeiridæ. *Epeira trifolium, marmorea, angulata* and *patagiata*, and of course the introduced house species.

Most of the transcontinental spiders extend to the eastern mountains or seacoast, where they were first known, but a few species cross part of the way from the west. *Epeira gemma* of California comes east as far as Medicine Hat. *Epeira aculeata* and *Sittacus rainieri* of the western mountains were found this summer along the Hudson Bay Railway in the same places as the rare *Habrocestum* (*Euophrys*) *cruciatum* and *Dendryphantes montanus* of the White Mountains.

A FURTHER REPORT ON THE VALUE OF DUSTING VERSUS SPRAYING TO CONTROL FRUIT TREE INSECTS AND FUNGUS DISEASES.

Lawson Caesar, Guelph.

At our last annual meeting I gave an account of my experience in 1916 in dusting fruit trees with fine sulphur and arsenate of lead dust compared with spraying with the liquid lime-sulphur and arsenate of lead. This year I again carried out a similar series of experiments.

Before giving my results for this year, it is perhaps wise to mention that this new dust treatment has aroused a great amount of interest among fruit growers and that they are anxiously waiting for definite knowledge as to its merits. Hundreds of machines would be purchased at once if it were certain that dusting were as satisfactory and reliable as spraying. The reasons for this are as follows: (1) Dusting requires only about one-tenth the time in the case of large trees that spraying requires. For instance, the total time for spraying a large 20-acre orchard in any one season would be about three weeks, whereas the time for dusting would be not more than three days. This would be a wonderful boon, especially when labour is so scarce and costly, and when other important work such as cultivation of soil is pressing. (2) Dusting can be done at almost exactly the right time, which of course it is the duty of entomologists and plant pathologists to determine. This means, for example, that one need never fail with dust to treat his trees for Codling Moth before the calyces have closed. With liquid spray it is often impossible in warm, good growing weather to do this. This promptness of application is just as important for Apple Scab and enables the grower to wait until the blossoms or leaves are in just the right stage and yet make sure all will be treated before they are too far advanced. (3) The outfit for dusting is not so heavy as a power spray outfit and will go through wet ground where the latter would mire. (4) Dusting is not nearly so dirty a job or so hard on clothes, face and hands or on horses and harness. It is true that at times it is hard on the eyes, but this can be largely prevented by proper goggles and in any case it is soon over and done with. (5) There is no time spent in returning for fresh material and no time worth speaking of lost in refilling.

With all these advantages it is no wonder that the fruit grower hopes dusting will take the place of spraying, though we may be sure he will ask about the comparative cost.

Comparative Cost of Dusting vs. Spraying.

We have not so accurate figures on the cost this year of dusting versus spraying, but they lead to the same conclusion as last year's, namely, that on large trees there is very little difference in cost between the two systems, whereas on smaller trees the liquid is considerably cheaper, though much will always depend upon the operator, as a careless man will be much more likely to waste dust than liquid.

Some Changes in Methods of Applying the Dust and in the Material Itself.

We used the same outfit this year as last, namely, the largest outfit sold by the Niagara Brand Spray Co. For grapes we added a short elbow to the pipe with a long opening facing towards the side so that the dust could be driven in at right angles or nearly so.

The materials this year differed chiefly in the fact that finely ground talc was added partly to act as a filler to the sulphur and lead or to the sulphur when used without the lead, and partly to keep it drier. Very fine sulphur alone tends to be sticky and will not scatter well.

The weather for the most part this spring was not calm enough to enable us to dust both sides of the trees on the same day by driving parallel with the wind and shooting the dust in at right angles; hence we were forced to dust at least one side directly with the wind. The fact is I adopted the method of dusting from at least three sides, or if changes of wind permitted it, from four sides, but lessened the quantity in each case, so that the total for each large tree would still remain approximately three pounds.

Acreage Covered per Day.

We never had a chance to test how much one man could do per day, but unless he became too tired he could probably cover at least twenty acres. We may say here that dusting is far from easy and many men cannot do it at all satisfactorily because they move their hands too slowly. There is need of special training for this work and the selection of a man who is not only quick with his hands but has also good judgment and intelligence.

Tests on Large Apple Trees.

Two orchards, which we shall call A and B, situated about three miles apart, both of which had been poorly treated the previous year and had borne almost unmarketable fruit, were chosen for the tests. Orchard A consisted of 262 trees and was about 7 acres in extent. Orchard B included about 9 acres but we treated only about 6 acres or about 200 trees.

In each orchard a block consisting of approximately one-quarter of the total number of trees was treated throughout with lime-sulphur and arsenate of lead. The remaining three-quarters of each orchard being moderately infested with San José Scale, received first a dormant or semi-dormant spray with lime-sulphur to kill the scale. Four rows, however, in each were dusted with sodium sulphide powder as a special test for scale. These trees as well as the remainder of the block in the later applications received only the sulphur-arsenate-of-lead dust. In orchard B only two dustings were given, the first just as the blossoms were ready to burst and the other just after the blossoms fell but before the calyces closed. In orchard A all the dust block received these same two applications, but fifty-three trees received an extra dusting on July 4th, three weeks after the blossoms had fallen. The object of this application was partly to see the effect on scab or sooty fungus, but chiefly to see how it affected Codling Moth.

Results on Foliage.

All the foliage was excellent this year, though that on the dusted area was a little better than on the sprayed, being in fact almost perfect.

Results on Apple Scab.

Orchard A had a crop of approximately 200 barrels fairly well distributed. The chief varieties were Greening, Baldwin and Golden Russet, but there were also a few barrels of Spy and in the dusted area one heavily laden tree of Snow. In

both liquid and dust portions on all varieties even on Snow there was less than 1 per cent. scab. A Snow tree in a neighbouring orchard across the fence had over 90 per cent. of scab, and Baldwins and Greenings in it averaged about 50 per cent. scab. These trees had received only the dormant spray for scale.

The part of orchard A that received only two dustings in addition to the dormant spray were just as free from scab as the part that had received three, thus showing the third application was not required for scab this year. This was generally true in most of the Province. In orchard B the liquid portion had not more than 1 per cent. scab. The dusted part varied greatly, some trees being almost totally free while others of the same variety had as high as 15 per cent. scab. The varieties were chiefly Greening and Baldwin. The average of scabby fruit would not be more than 10 per cent. The crop was very light, only about twenty barrels on six acres, so that the test was not a good one. About three acres of the orchard not in our blocks had received the dormant spray and part of the pre-blossom spray. This part showed from 20 per cent. to 80 per cent. scab.

Results on Sooty Fungus.

There was practically no Sooty Fungus even in unsprayed orchards in the district.

Results on Codling Moth.

Codling Moth this year almost all over the Province was exceptionally abundant and caused more than the usual percentage of wormy fruit. This was partly due to the smallness of the crop with the consequent greater number of larvæ attacking the individual apples than if there had been a larger crop and more apples for the worms to distribute themselves among.

In orchard B where no later spraying or dusting than the regular calyx application was done, fully 50 per cent. of Baldwins and Kings were wormy, and about 25 per cent. of R. I. Greenings. There was very little or no difference in the efficiency of the dust compared with the liquid. Almost every worm in each case had entered through the side. On unsprayed trees in the same orchard the percentage of wormy fruits varied from 60 to 90, and of these 50 per cent. or more entered by the calyx.

In orchard A the dust gave just as good results as the liquid where both parts received only the one application for Codling Moth, but both were quite wormy, having as high as 30 per cent. of the fruit infested. The block of fifty-three trees that had received a second dusting three weeks after the blossoms fell showed a great improvement over the rest and had not more than 10 per cent. wormy fruit.

Dusting for San José Scale.

Last year I tried sodium sulphide dust mixed with hydrated lime upon large apple trees before the buds burst as a method of killing San José Scale. The work owing to certain difficulties was poorly done and the results not satisfactory.

This year I planned to dust four rows of trees, forty-eight trees in each case, with sodium sulphide mixed with talc. Several trees in each plot were badly infested. In orchard B both sides of the trees were dusted, dusting of one side being just after a rain, but the other when the trees were dry. Parts of both sides were re-touched. In all about five pounds per tree were used, so that the mixture was given a good chance.

In orchard A the weather during our work was continuously dry, and after dusting one side of the trees I felt so certain that the mixture would not kill the scale that I merely applied the remainder of my material to the same side and did the other side very thoroughly with lime-sulphur.

RESULTS. To my great surprise this year no scale was found on either of these plots. The fact is that we made such a cleaning up of the scale in both orchards that only two scales in all were found and these might easily have been introduced by a bird or insect. I am not surprised at the results from the liquid, but I am surprised at those from the sodium sulphide dust. I thought that if the trees were moist one could hope for such results, but from my observations I did not hope for it when the dusting was done on dry trees. The results clearly justify further tests.

Results Obtained from Dusting Elsewhere in Ontario.

At Guelph, Prof. Crow used the sulphur-arsenate of lead dust on his apple orchard, but failed to control the scab. About 66 per cent. of Snows and 50 per cent. of Spy are scabby, and other susceptible varieties are also dirty. There is very little doubt that with liquid spray he would have succeeded much better.

At Brighton an able fruit grower spent much money on dusting his large orchard and gave more than the regular number of applications, but was much disappointed with the results. Two other equally good growers not far from him treated their orchards with liquid and had beautifully clean fruit, nearly 99 per cent. free from scab. One of these orchards received only three applications in all.

At Whitby about half of the Government demonstration orchard was sprayed with the liquid and the remainder dusted. The results were decidedly in favour of the liquid, though the utmost care was taken to do the dusting well and at the right time, and though extra applications were given in all weather favourable to scab. Dusted Snow trees there had as high as 50 per cent. scab.

Conclusions Regarding the Merits of Dust for Apple Orchards.

In spite of the excellent results I obtained last year and again this year, I fear very greatly that it will be much safer to continue to use the liquid spray at least for a number of years longer until improved dust substitutes or improved machinery or both are available, and until a larger percentage of those who test it can obtain satisfactory results. A duster could, of course, on a large fruit farm help to tide over an emergency where an extra treatment must be given quickly. The great weakness of the dust method in my opinion is its failing to adhere sufficiently long in wet weather to the fruit and foliage.

A Valuable Field Other Than Apple Orchards for the Use of Dust.

Our experiments in two excellent sweet cherry orchards, each consisting of about ninety large trees of several varieties, has shown a very valuable use for dust. Everyone who knows much about sweet cherries knows that it is very difficult, especially in warm, moist weather, to keep the crop from being ruined or nearly ruined by the Brown Rot fungus. The trouble hitherto has been that while liquid spraying either with lime-sulphur or Bordeaux mixture would ward off this disease as long as the mixture remained on the fruit, these substances could not be applied near enough to the time of picking to prevent rot attacking the fruit then, because they would stain the fruit so much that it could not be marketed.

The sulphur dust, however, without any poison in it gets over this difficulty, because it does not stain anything. It may, therefore, be applied even a day or two before picking and unless followed by prolonged heavy showers will protect the fruit until it is marketed.

Having thought of this plan we tested it out on the above-mentioned sweet cherry orchards. The fruit was kept clean up to a few days before picking—in one orchard by three well-timed applications of liquid lime-sulphur and in the other by two of these and one dusting. These were followed in both orchards by a thorough dusting one or two days before picking. As a result in one orchard there was less than 1 per cent. of rotten fruit, in fact my assistant placed it at 1/10 of 1 per cent., though a large check tree in a more exposed situation had over 80 per cent. of infected cherries. Moreover, in spite of the weather this year being very favourable for rot and causing great losses to cherry growers, the owner told me that this was the first time in many years he had been able to harvest the fruit off several of the trees that were specially susceptible to the disease.

The other orchard was a little later in maturing its fruit and was subjected to several very heavy rains before it was all picked. These washed the sulphur off the later fruit. Nevertheless all the earlier varieties yielded a very clean crop and it was only on the later varieties that any appreciable amount of loss occurred, though even here there was not much loss. An extra dusting of these trees would have prevented this.

Since the Brown Rot of cherries attacks also plums, it is clear that the same plan could be used of protecting varieties very subject to this disease.

It takes so few minutes to dust 100 cherry trees that a dozen fruit growers could purchase a duster among them and thus make the cost to each very little. The cost of the material, namely, sulphur with ground talc as a filler, in normal times would be $3.00 or less per 100 pounds, which is less than half the cost when arsenate of lead is added to the sulphur, so that the material would not be very expensive. We feel that the adoption of this method of preventing rot would mean the saving of many thousands of dollars annually to growers of stone fruits.

Father Leopold: Have you tried dusting for the control of scab of pears?

Prof. Caesar: We did not try dusting on any variety of pears subject to scab, and I cannot speak regarding that.

Father Leopold: This year for the first time we have sprayed our 65 acres of orchard by dusting instead of with liquid spray. The liquid spray machine we had before was burnt in the fire. For apples we had a marvellous success all along, but we had the worst and most scabby pears I have ever seen in my life. We had good success last year on pears with lime-sulphur wash. I think the leaves are so glossy that the dust will not stay on, and of course this applies to the fruit also. The leaves and fruit of the apple tree are more hairy, and the dust will stick on better. I may say that we had 85 per cent. clean fruit in the 65 acres of orchard, but the MacIntosh was especially good—95 per cent. clean. We had a loss with Wealthy because they were not properly sprayed. None of the Wealthy apples ever had scab before, but of course this has been an exceptionally bad year. With regard to Codling Moth, wherever two sprays were applied we had very good success. Last year we had over 35 per cent. Codling Moth in our orchard, but this year the orchard was clean and free from Codling Moth to the extent of 90 per cent. We made no liquid sprays at all this season.

Mr. Petch: With regard to the value of spraying against dusting, I do not think it matters very much which you use so long as it is done thoroughly and repeatedly. This year was a very bad year for scab and we dusted and

sprayed, in order that we might test out both methods. The results were 99 per cent. clean fruit on the sprayed portion and 97 per cent. to 98 per cent. on the dusted portion. The sprayed portion received one more spray, i.e., the dormant spray, otherwise the orchards were sprayed as far as possible on the same day, and there was no division at all in the orchards: it was all done in one orchard, side by side, taking 90 trees in each portion. With regard to dusting I have found that a man who has had a little training in dusting will be apt to have better success than a man with a longer training in liquid spraying. It takes a very good man to spray a tree, whereas a man taught for a very short time with a duster can get good results. I have found that a man spraying for several years will sometimes miss branches of certain portions of the tree with the spray, and on those branches there will be scab, but there will not be even one scabby spot in the dusted portion. We sometimes find that a limb or branch has been overlooked on trees with the heaviest crop of apples, and every apple on these limbs will be affected by scab, and of course this means that the apples are put into class 2 or 3. In the dusted portion the dust settles all over the tree, and does not require the careful attention to reach every branch that the spraying does. Professor Caesar may differ from me in this, but that is my experience, and as regards spraying I may say that we have a very good example in an old orchard badly infested with scab which I think was well known to Macdonald College men last year. The man had the cleanest crop of Fameuse in the Province of Quebec, after spraying thoroughly four times. This year he said: "I am not going to get a large crop anyway, and I am not going to bother very much about spraying." He sprayed the Fameuse once and the others he did not spray at all, with the result that there was 88 per cent. scab. Last year he had 98 per cent. clean fruit in a year which was just as bad as this has been for scab. Last year out of 1,050 barrels packed 1,010 were 2's and 3's, but this year although our crop was not so large we had about 97 per cent. clean fruit. I spoke last night about what can be done by reaching the farmers. Some of these men have sprayed ever since the spray has come into the county, and the Demonstration Orchard men have been sent out to them and have stayed with them for years, and yet this year nearly half, or at any rate a quarter, of their apples were No. 3's.

FATHER LEOPOLD: What percentage of fillers did you use? We have been using 60 per cent. to 40 per cent. fillers in our orchards.

MR. PETCH: A mixture of 45 per cent. fillers to obtain these results.

PROF. CAESAR: I think Professor Brittain made some tests with the dust.

PROF. BRITTAIN: We did make some tests this summer, and our results were so very uneven that I find now I do not know nearly as much about the matter as I thought I did in the spring. We used various strengths of sulphur—40 per cent. to 90 per cent.—through the different orchards. The head of the Botanical Branch and I each took over a small orchard for testing purposes, and I may say that he had the better one—an orchard that has been properly looked after for years, one of the best sprayed orchards in the district, on light sandy land, with splendid air drainage, and with trees well pruned. I took one on heavy clay land, with poor air drainage and poorly pruned trees. He had good results, fruit over 90 per cent. clean, and found with regard to dusting that he had better control with 95 per cent.-90 per cent. than with 50 per cent. With spraying he got slightly better results than with any of the dusts, but on the best dusted fruit the difference was negligible. My orchard had 40 per cent. scab and the worst outbreak of Tussock Moth I have ever known. The Tussock Moth

chewed holes in both sprayed and unsprayed portions. My dusted fruits were 90 per cent. scabby, and the check was 100 per cent. scabby. Did Prof. Caesar ever try tobacco dust?

PROF. CAESAR: Not that we could call a fair test and draw conclusions from.

PROF. BRITTAIN: I was very disappointed. A man in New York State assured me that it was a very efficient control for aphids. Green Apple Bugs were present in large numbers and we tried it, with the result that the Green Apple Bugs were chasing themselves around the tree just as lively as ever, and we had only one casualty in the whole tree.

FATHER LEOPOLD: How many times did you apply the dust?

PROF. BRITTAIN: Four times.

PROF. CAESAR: Perhaps Prof. Bunting can tell us something about this.

PROF. BUNTING: No. I may say, however, that I think it would be well for fruit growers to go cautiously at the present time with dust spraying. There seems to be a big difference of opinion amongst men who have been experimenting with both. We know that the liquid spray is very effective and a satisfactory control for most of our orchard pests. Someone has described an ideal spray as one that can be applied with the least inconvenience, in the shortest space of time, will control the largest number of pests for the longest possible season. No doubt dusting machines have done good service, but the fruit grower must have a dust machine and also a liquid machine to spray an orchard at the present time. I think it would be wise for the average orchardist to go cautiously in adopting the dusting machine.

PROF. CAESAR: Where the same man did the work in an orchard at Whitby the liquid spray gave much better results than dusting. I do not advocate the purchase of a dust sprayer for the average fruit grower.

A FEW NOTES ON THE ECOLOGY OF INSECTS.

W. LOCHHEAD, MACDONALD COLLEGE, P.Q.

In its broad aspect the ecology of insects deals with these animals in relation to their environment. It is evident, therefore, that a short paper such as this cannot discuss adequately the whole field of relations between insects and their environment, for this would require volumes. The object of this paper, however, is to touch briefly upon a few aspects of the subject with the hope that more attention may be given to the study of the problems involved to the end that they may help in solving some of the problems relating to the control of injurious insects.

INTER-RELATIONS BETWEEN INSECTS AND PLANTS.

Long continued observations show that there are "all grades of association between plants and insects from most casual contact to mutual dependence, and that there are grades of fitness on both sides." (Needham, *General Biology*.) The important part played by many insects in the fertilization of plants is well known. To this end many beautiful adaptations occur among plants such as in legumes, iris, milkweed, yucca, orchids, mints, figworts, honeysuckles, canna, Smyrna fig, etc., but it should be borne in mind that there has been also much adaptation on the part of the insects.

Another type of inter-relation is the *galls* seen on many plants, produced by certain insects. The chief gall-producing families are the *Cecidomyiidæ Trypetidæ, Aphididæ, Psyllidæ, Cynipidæ* and *Tenthredinidæ*. Mites (*Acarina*) also produce galls. Usually an egg is laid the growing tissue and the larva excites the surrounding tissue to abnormal growth. The transformations occur within the gall, and the adult escapes.

Galls are of various forms, often characteristic of the insects producing them. The nutritive cells lying next to the contained larva contain both sugar and starch and appear to function as feeders for both the larva and the growing cells of the gall, as our fellow-member Dr. Cosens has most admirably shown in his recent studies.

Insectivorous Plants.

Certain plants such as the sundew, Venus's fly-trap, pitcher-plant and bladderwort entrap small insects and feed upon them. These plants secrete digestive fluids which convert the tissues of the captured insects into liquid food capable of being absorbed.

Bacteria and Fungi.

Many caterpillars die from bacterial diseases. Silk-worms, cabbage worms, army worms, gypsy moth caterpillars, grasshoppers and tent caterpillars are frequently killed by bacteria. Certain fungi also destroy insects. *Cordyceps* destroys white grubs, wireworms and many caterpillars; *Empusa* is often responsible for the destruction of house flies, plant lice, grasshoppers, crickets and caterpillars; and *Sporotrichum* kills many kinds of insects. Attempts have been made to control chinch-bugs and grasshoppers by artificial cultures of *Sporotrichum* and *Coccobacillus*, but only with partial success.

Insects as Carriers of Plant Diseases.

Flea-beetles by eating holes in the leaves of potato permit the entrance of the spores of Early Blight (*Macrosporium solani*) and consequent partial destruction of the leaves. It has also been shown fairly conclusively that certain aphids and other insects* act as carriers of Twig Blight (*Bacillus amylovorus*) of apples and pears, and it is now believed that the Squash-bug (*Anasa tristis*) the Striped Cucumber Beetle (*Diabrotica vittata*), the Twelve-spotted Cucumber Beetle (*D. 12-punctata*), the Cucumber Flea Beetle (*Epitrix cucumeris*), the Melon aphis (*Aphis gossypii*), and the 12-spotted Ladybeetle (*Epilachna borealis*) frequently inoculate the stems of cucurbits with the cucurbit wilt (*Bacillus tracheiphilus*). Again, the punctures made by the Plum curculio in plum, cherry, and peach permit the entrance of the spores of the Brown Rot disease (*Sclerotinia fructigena*). Tree crickets (*Oecanthus* spp.) are said to be responsible for the inoculation of trees and shrubs with canker, of raspberries with the Cane Blight, and probably for the production of other diseases.

Inter-relations of Plants and Insects in Nature.

The idea of inter-relations in Nature was first emphasized by Sprengel, Darwin and Müller, and later ecological studies reveal still more clearly how

*Gossard mentions among others *Aphis avenæ, Empoasca mali, Eccoptogaster rugulosus*, and *Lygus pratensis*. "Any sucking insect can become a carrier, also any insect with the bark-burrowing habit."

all Nature is linked together into a system, one part dependent upon another in an intricate web of life. Disturbances in one portion of the system are followed by disturbances in another. We have already indicated in previous sections some of the relations between insects and plants, between insects and birds, and between insects and their parasites. Numerous other relations might be mentioned but these are sufficient to show that a knowledge of these relations is an important part of the equipment of the economic entomologist who would deal successfully with the problems confronting him.

In a region undisturbed by man the various parts of the system of Nature have practically reached a state of balance through the ceaseless action for long ages of the "struggle for existence." Plant struggles with plant, animal with animal, and both with the environment. With the advent of man, however, the balance has been disturbed by the clearing of the forests, the cultivation and drainage of the land, the growing of crops, and the introduction of foreign plants and animals, since the new set of conditions will be favorable to the increase in numbers of certain plants and animals, including insects, and unfavorable to others. This disturbance is often widespread. Favored insects will multiply rapidly on account of the abundant supply of food furnished by the cultivated crops, faster at first than their parasitic enemies; and insectivorous animals such as snakes, toads, birds and predaceous insects will be deprived of the necessary shelter and hiding places by the clearing of the land, and become less abundant.

On the other hand insects not favored by the destruction of their food plants under the new conditions will diminish in numbers, as will also their parasites, both sometimes no doubt to the verge of extinction. If, however, as is sometimes the case, conditions again favor the insect it will multiply very rapidly because the development of the parasite lags behind its host. Moreover, there is always a limit to the increase of the parasite, otherwise it would exterminate its host, and eventually itself.

Again, the development of insects is sometimes influenced by the soil conditions. For example, sandy or gravelly soils seem to favor the multiplication of such insects as the plum curculio, and the grape root worms. But another factor, namely, the influence of the soil on the plant, must not be overlooked. Plant growth on sandy and gravelly soils is retarded and is to a certain extent abnormal, and the plant is less resistant to attacks of insects. On the other hand, strong rich soils may induce vigorous growth, also to a certain extent abnormal, when the plant is preyed upon by certain insects like plant lice and scale insects which thrive best upon succulent growth.

This relationship of soil insects to climate and soil conditions has been recently discussed in the *Agricultural Gazette* by Dr. A. E. Cameron, of the Entomological Branch, Ottawa, who is attempting to get some definite information out of the chaos of many apparently conflicting observations, a condition due mainly to the imperfect determination of the measure of the operation of many factors. He finds that phytophagous insects of the soil frequent those soils where their food plants thrive, but as these plants depend on the type of soil—its structure, texture and composition, temperature and humidity, it is clear that these insects depend on the type of soil.

Again, predaceous soil forms are dependent on the presence of phytophagous soil forms, and a change in any one of the factors constituting a habitat will have an influence on the fauna.

As a physical index of the varied conditions controlling soil insects it is believed that the evaporating power of air is the most important one, inasmuch

as it is an expression of the combined effects of air, temperature, pressure. humidity, wind velocity.

This whole subject requires much additional study.

The inter-relations of plants and insects become more involved when it is known that certain varieties and species of economic plants are more liable to attack by insects than other varieties and species. Treherne in a recent article in the *Agricultural Gazette of Canada* brings forward some instances of this kind. Spring wheat in certain localities in British Columbia is severely troubled with the wheat midge, while fall wheat is seldom attacked. But he notes that the early and late sowings of the spring wheat are not so seriously injured as the mid-season sowing. Again, the grape-blossom midge injures the early varieties of grapes, such as Morris Early, Warden, Champion and Massasoit, more than the Concord. In the serious invasion of the Hessian Fly in Ontario in 1900-01 the writer observed that certain varieties of wheat were injured more than others. The Imperial, Egyptian and Michigan Ambers, Walker's Reliable and General Grant, were but slightly infested, while Dawson's Golden Chaff, Turkey Red, Treadwell and Red Chaff were badly affected. At the same time it was observed that the Dawson's Golden Chaff was not seriously attacked in New York State.

Treherne also notes that the Northern Spy apple is practically immune from the woolly aphis, the Leconte and Kieffer pears from the San José scale, black currants and lettuce from *Peridromia saucia* cut-worm, and the red Dutch cabbages from the cabbage root maggot. In addition, he says: "The forest tent caterpillar (*M. disstria*) attacks sugar maple in preference to the soft maple, the latter being comparatively free from attack. He also records the fact that the spiny elm caterpillar (*Euvanessa antiopa*) rather seriously injures American elms, while Scotch and English elms are not preferred. Similarly, the maple scale (*Pulvinaria innumerabilis*) rarely injures the sugar and Norway maples, but attacks especially the soft maples. Dr. Felt has further rated various shade trees in New York in their order of susceptibility or immunity from attack by insects. The European elm sawfly (*Kaliosysphinga ulmi*) attacks the English and Scotch elms, including the Camperdown variety, in preference to the American elms (Slingerland, Cornell). The elm leaf beetle (*Galerucella luteola*) is reported as most seriously infesting the European elm and when other species of elm were found growing nearby preference seemed to be shown for it (Burgess, Illinois). The European elm scale (*Gossyparia spuria*) attacks the American elms more seriously than the imported English elms. (Doten, Nevada.) The fruit-tree bark beetle (*Euzophera semifuneralis*) clearly prefers the European or imported varieties of plum, but does occur in the native kinds; *Prunus simoni* has, however, thus far been worst affected by it. (Sanderson, Delaware). The white peach scale (*Diaspis pentagona*) a very polyphagous feeder, does not attack the Le Conte and Kieffer pears. (Gossard, Florida). The apple maggot (*Rhagoletis pomonella*) is noted particularly in the sweet and sub-acid summer varieties, while fall and winter sorts, including acid varieties are less infested. (Quaintance, U. S. Bureau.) The brown mite (*Bryobia pratensis*) is seldom observed on quince and apricot, although it attacks a great variety of trees including almonds and peaches. (Weldon, Colorado). The use of resistant vines against the grape phylloxera represents a good example of the value of selection. The wild vines of the Mississippi Valley states which have evolved in company with the *Phylloxera* possess the more resistant forms. The European vine (*V. vinifera*) is the most susceptible of all in California. (Quayle, California.)"

Insects and Birds.

When it is known that about two-thirds of the food of our common birds consists of insects, it becomes evident that the agency of birds in the control of insects is of the highest importance. The seasonal diet of the robin, blue bird, catbird, king-bird, flycatchers, chickadee, wren, swallow, woodpecker, cuckoo, night-hawk, warblers, oriole, and the other birds has been carefully studied in recent years, with the resulting discovery that insects form in most cases their only food, and only at certain seasons are small fruits eaten.

Birds are no doubt of special value to the farmer in nipping incipient scourges in the bud on account of their ability to move rapidly from place to place in search of food, and on account of their varied character and habits. Especially is this true of our winter birds which search every cranny and nook for the hibernating forms of insects at a season when every form destroyed means in most cases the absence of hundreds of thousands of their progeny the following summer.

Insect Behavior Toward Stimuli.

In recent years a large mass of facts regarding the behavior of insects to their environment—both organic and inorganic—has been accumulated, and in a few cases this information has been of service in the control of injurious forms. In general, however, the application of such methods of control is still in its infancy stage, but it gives promise of valuable results in the near future.

As the relations of insects to plants and to other insects have been discussed in previous sections, attention will be confined here to the behavior of insects under the influence of environmental stimuli such as light, heat, moisture, chemical contact, winds, etc.

For some time it has been known that plants show tropistic movements with regard to light, heat, gravity, moisture, contact, etc. Moreover, some progress has been made towards an understanding of the processes. Plants, for example, bend towards the light because the cells on the side away from the light grow faster than those on the side next the light. There is no conscious control of the movement by the plant. Animals, too, exhibit movements under the influence of tropic, or rather, taxic stimuli. In the case of insects, butterflies, bees, house flies, and many moths and caterpillars are positively phototropic or phototactic, and move towards the light, while maggots, bed bugs and cockroaches move away from the light.

Again, most moths move away from sunlight but move towards a lesser light such as electric or oil lamps. Davenport explains this difference by saying that "butterflies are attuned to a high intensity of light, moths to a low intensity." Loeb explains the circling of moths and other insects about a light. The stimulus orients the insect by its more intense action on the muscles next the light, and the insect then moves towards the light.

Loeb states that caterpillars of the Brown-tail Moth as they emerge from hibernation in spring are positively phototaxic, but after they have eaten this response disappears, showing that taxic reactions are sometimes dependent on the state of the body.

"Swaine finds that the destruction of piled logs by the wood-boring larvæ of the sun-loving *Monohammus* can be prevented by forming a dense shade over the logs by means of brush. In his study of the army cut-worm (*Euxoa auxiliaris*) in Alberta, Strickland found that the larvæ are negatively phototropic and hide

beneath the soil till about four or five o'clock in the afternoon when they come to the surface to feed. With the weaker light they become positively phototropic and a general migration in a westerly direction takes place. When food is scarce hunger may overcome their aversion to sunshine with the result that the larvæ come above ground, but they still display a modified negative phototropism and migrate in a north-westerly direction. These facts are of practical value in controlling outbreaks of this insect." (Hewitt.)

Insects are very responsive to the stimulus of heat, i.e., they are thermotactic. Some insects respond to the stimulus of touch or contact, and are said to be either positively or negatively thigmotactic. Cockroaches are in the habit of squeezing into narrow crevices, and Loeb mentions the case of a moth (Pyrophila) which also has the same habit.

Chemical substances and foods also act as stimuli influencing the movements of insects. Maggots orient themselves with regard to their food and then move towards it, the orientation being the result of unequal chemical stimulation of the muscles of the two sides of the body. The deposition of eggs by most insects on certain plants is also the result of chemotropism. The house fly and many piercing insects such as the biting flies and mosquitoes are repelled by phenol and other coal tar products.

Wheeler and Loeb give several examples of geotropism among insects. They observed that lady-birds and cockroaches at rest placed themselves on vertical rather than horizontal surfaces.

Observations show that taxic* reactions are very adaptive. Ants and aphids are positively phototaxic when they get wings; and honey bees are periodically phototaxic, thus leading to swarming. Ants, moreover, are strongly thermotaxic, thus securing for their brood the optimum temperature conditions.

Relation of Insects to Temperature and Humidity.

Two important factors influencing the life of insects are temperature and humidity. Their general regulatory action has been known for a long time, but scientific data obtained in recent years enable us to speak more definitely regarding the behavior of insects toward the varying temperature and humidity of their environment.

Pierce in his studies of the Cotton Boll Weevil and other forms says: "A careful study of the records of any species, charting for the time required for each activity and the temperature and then similarly for the humidity will disclose temperature and humidity points of maximum efficiency. With the Boll Weevil these points lie approximately near 83 deg. F. and 65 per cent. relative humidity."

Ewing has found that a constant temperature of 90 deg. F. prevents the development of *Aphis avenæ*, and that the optimum temperature for the production of the wingless agamic forms is about 65 deg. F. The larvæ of the common House Fly are killed at a temperature of 105 deg. F., and the close-packing of manure is sufficient to prevent the breeding of flies.

With regard to changes in humidity insects vary somewhat widely in their reactions. For example, moist air is favorable to most aphids and hastens the development of the larva of the Hessian Fly. On the other hand dry seasons favor the development of the Chinch Bug and the Wheat Midge.

The investigations of Bachmetjew show that humidity is an important factor modifying the effects of temperature, and that the metabolic activities of insects

*The term *taxic* is now more commonly used than *tropic* when applied to the movements of animals under the action of stimuli just referred to.

are related to both temperature and humidity. He says: "Apparently there is a degree of atmospheric humidity which being the most favorable to the maximum speed of insect metabolism should be designated as the optimum: that this optimum varies for each species, for each stage of each species, and for each stage of each individual.

It is a well-known fact that most species of *Thrips* and Red Spiders are more abundant, and hence more injurious, under warm dry conditions.

The Codling Moth is an example of a common insect whose development is greatly influenced by weather conditions. Even within the limits of a single state or province the rate of its development and the time of its stages are influenced by latitude, by early and late seasons, by cool and warm seasons, and by wet and dry seasons. The student will find in the observations of Simpson in Idaho, Pettit in Michigan, Sanderson in New Hampshire, Caesar in Ontario, Headlee in Kansas, Siegler and Simanton in Maine, Brooks and Blakeslee in Virginia, and Forbes in Illinois much valuable data for investigations on the relation of insects to climatic factors.

FRIDAY AFTERNOON, 1.30 O'CLOCK.

A motion picture film on "Field and Parasite Work on the Gipsy and Brown-tail Moths" was shown by Prof. Burgess in the local moving picture theatre.

The use of this film was obtained by courtesy of the U. S. Bureau of Entomology. It was followed immediately by another excellent film illustrating "Orchard Spraying in Nova Scotia," shown by Prof. W. H. Brittain.

THE EFFECT OF STABLE AND HORN FLY ATTACKS ON MILK PRODUCTION.

A. W. Baker, O. A. College, Guelph.

At the annual meeting of the Society in 1916 the writer gave a paper on "Some Repellents for Stable and Horn Flies on Cattle." At that time the question was raised as to whether or not fly attacks had any effect on milk production. Accordingly during the summer of 1917 a spraying experiment was carried out with milch cows in an endeavor to find the effect of fly attacks on milk production, or rather the benefit to be derived from a prevention of these attacks.

Two lots of five cows were selected. Unfortunately, one cow aborted during the course of the experiment, so that milk records could be kept of only four cows in one lot. From July 17th to July 31st one lot was sprayed once a day and the other lot left unsprayed. From Aug. 1st to Aug. 12th the lots were reversed in spraying and from Aug. 13th to Aug. 25th the lots were again reversed. In taking the milk records the first two or three days of each period were discarded, leaving 10 days in which the effect on yield was considered.

During the first period and part of the second, the cattle were sprayed before the afternoon milking. During the remainder of the second period and the third period spraying was done before the morning milking.

The following table shows the lots of cows, sprayed and unsprayed, with the milk production of each cow for the last ten days of the period and the total milk production of the lot for the same time.

TABLE OF MILK PRODUCTION.

July 17th—July 31st.				Aug. 1st—Aug. 12th.				Aug. 13th—Aug. 25th.			
Lot.	Cow.	Milk.	Total Milk.	Lot.	Cow.	Milk.	Total Milk.	Lot.	Cow.	Milk.	Total Milk.
		Lbs.	Lbs.			Lbs.	Lbs.			Lbs.	Lbs.
A	6	281.3	1012.8	B	188	299.8	911.8	A	6	230.6	880
Sprayed.	7	191.1			194	210.7			7	182.7	
	10	127.6			193	150.7			10	82.6	
	191	263.6			232	250.6			191	247.3	
	185	149.2							185	136.8	
B	188	312.3	972.9	A	6	253.7	911.5	B	188	255.6	788.2
Unsprayed.	194	244.7			7	186.7			194	196.0	
	193	141.7			10	85.5			193	129.1	
	232	274.2			191	241.1			232	207.5	
					185	144.5					

It must be borne in mind in examining these figures that there is a normal loss in milk production from the middle of July to the end of August irrespective of fly attacks. This loss is due of course to drying up of pastures and was especially evident in 1917. Under normal conditions this loss is gradual, so that in three periods such as used in this experiment the middle would represent practically an average of the first and last.

An examination of the table of milk production shows us that such an average production during the middle period was not evidenced where the cattle had been sprayed for part of the time.

Lot A during the first period of ten days, sprayed, gave 1,012.8 lbs. of milk. and in the third period of ten days, also sprayed, gave 880 lbs. of milk. During the second, or unsprayed period, the lot, however, gave 911.5 lbs. of milk, which is 35 lbs. or approximately 4 per cent. *less* than the average of the two sprayed periods.

Lot B during the first period, when unsprayed, gave 972.9 lbs. of milk and in the third period, also unsprayed, gave 788.2 lbs. During the second, or sprayed, period this lot gave 911.8 lbs. of milk, which is 31 lbs., or approximately 3¾ per cent. *more* than the average of the two unsprayed periods.

A comparison of the production of the two lots serves more strikingly to point out the benefit derived from spraying. Lot A containing 5 cows in the first ten days when sprayed produced 40 lbs. more than lot B containing 4 cows unsprayed. In the third period lot A of 5 cows sprayed produced 92 lbs. more than lot B of 4 cows unsprayed. In the second period, however, lot B of 4 cows sprayed produced a fraction of a pound *more* than lot A of 5 cows unsprayed.

This comparison of the two lots also shows the advantage of morning spraying. Lot A in the first period when sprayed in the afternoon gave only 40 lbs. more than lot B unsprayed, whereas the same cows in the third period, when sprayed in the morning, gave 92 lbs. more than the unsprayed lot. The afternoon spraying was less than 50 per cent. efficient as compared with the morning spraying.

due of course to the fact that the cows had poor protection during the heat of the day, when fly attacks were at their height.

We find that the increased milk production through the use of a repellent in certain periods was approximately 4 per cent. in those periods. However, since the afternoon spraying, which was carried on over considerably more than one-third of the time, was less than 50 per cent. as efficient as the morning spraying it follows that the production during the period when morning spraying was practised must have been increased nearly 6 per cent. I should say in this connection that, due to difficulty in securing assistants for summer work on the department, we were forced for a time to use inexperienced and somewhat incompetent help and I feel that there were times when the spraying was not as thoroughly done as was necessary. Accordingly, we feel that another season's work will give even more marked results.

In considering the increase in milk production through protection of cattle from fly attacks by the use of repellents, it must be borne in mind that this increase in production is secured without any increase in plant, stock or equipment. There is also no increase in overhead save the cost of the spray material, as the time required for spraying is so short that no additional help is required. Two men should spray a herd of thirty cows in 25 to 30 minutes.

The repellent used in this work was a home-made spray mixture, a modification of the repellent described in the paper given at the last annual meeting of the Society.

The ingredients are as follows:—

Kerosene	1 gallon
Slightly sour milk	1 "
Fish Oil	1 "
Strong hot soap solution (about ½ cake laundry soap)	1 "
Oil of Citronella	6 ounces

The kerosene and milk are mixed and thoroughly agitated to form an emulsion; the fish oil and hot soap solution are then mixed and thoroughly agitated and the two emulsions are then mixed and the whole very thoroughly agitated. The 6 ozs. of oil of citronella is stirred in when the mixture is cold. This makes quite a stable stock solution. It is advisable, however, to stir up the stock solution thoroughly each time any is taken out. When not in use the stock solution should be kept covered.

The materials for this four gallons of stock solution cost about $1.83. In the work outlined here the repellent was used in the proportion of one part of stock solution to two parts of water. The mixture as applied, therefore, cost 15¼ cents a gallon. In the proportion of 1 to 2 of water 1 gallon as applied should suffice for one spraying for about forty cows. The cost of the spray material used in the experiment was therefore about 55 cents.

The pump used was a small, cheap hand sprayer of the atomizer type, such as is used for spraying small garden patches.

NOTES ON TWO UNUSUAL GARDEN PESTS IN NOVA SCOTIA.

W. H. BRITTAIN, PROVINCIAL ENTOMOLOGIST FOR NOVA SCOTIA.

THE POTATO STEM BORER (*Gortyna micacea* Esp.)

Like so many of our injurious insects this species is evidently introduced from Europe. A short description of the larva is found in Newman's "British Moths." Stainton, in his "Manual of British Butterflies and Moths" Vol. 1, p. 198, states that the larva feeds in the roots of various Cyperaceæ. In "British and European Butterflies and Moths" by Kappel & Kirby, it is said that the larva lives in the roots of *Glyderia spectabilis*, etc. Buckler in his "Larvæ of British Butterflies and Moths" states that the larva feeds on *Equisetum*. He gives the following account of the larva:—

"Larva of *H. micacea*, three-quarters grown, 1 1/16 in. long. The color of the back and sides down to the spiracles was a rather deep purplish red-brown without gloss, and a little paler on the thoracic segments and at the divisions; the sides below the spiracles and belly and the legs were paler and of a dingy flesh color; the head, ochreous brown, the mandibles blackish brown; a polished ochreous brown semi-circular plate on the second segment rather broadly margined in front with blackish brown; a small shining pale ochreous plate on the anal tip, having a terminal border of very small dark warts. At the beginning of July the larva has attained 1⅜ in. long, having meanwhile grown paler on the back and by the tenth of the month the upper and lower surfaces were both alike, of a deep smoky dull flesh color. In this case the larva had fed on Equisetum, but at this date it ceased feeding and excavated a hole in the earth at the side of its pot; in which by the 15th it emerged to a light ochreous brown pupa ¾ in. long from which the moth emerged in August, 1914."

Miss Omerod publishes an account of certain outbreaks of the insect in potato stems in her report on injurious insects for 1898. One outbreak occurred at Fyvie, Aberdeenshire, Scotland, and reports of similar outbreaks were received from Melton Mowbray and from Daleally, Errol, N.B., but in this case no moth was reared. She states that larvæ sent in July 20th pupated the third week in August and moths appeared the middle of September. This fairly closely approximates the life history of the insect as determined for Nova Scotia. In "Entomological Notes" in the Journal of the Board of Agriculture, Vol. 4, p. 519, there is a brief account of the insect and its work. Grünberg, in "Die Süsswasserfauna Deutschlands," published at Jena in 1910, gives a description of the adult of this insect and discusses the food habits of the larvæ, mentioning *Carex*, *Rumex* and *Iris* as host plants.

The insect was first recorded as occurring in Canada by Mr. Gibson in the 39th Annual Report of this Society, pages 49-51. Mr. Gibson summarizes the literature dealing with the pest and records its discovery at two widely separated points, viz., Westport, N.S., and Tramore, Ont. In both cases the larva was boring in a corn stalk.

The moths have also been taken by Mr. McIntosh at St. John, N.B., who records the insect under the name *Hydroecia medialis*, Smith. The writer records the ravages of the insect in Nova Scotia in a short article published in the Proceedings of the Nova Scotia Entomological Society for 1915, pp. 96 and 97.

No records of complaints of the work of the insect can be found until the summer of 1914, when serious damage was reported to potatoes in gardens at Yarmouth. Specimens of larvæ were obtained and adults reared to maturity from this material. In the same season the rhubarb plantation at the college was visited by a serious attack of this pest which practically destroyed the crop both

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Potato Stem Borer (*Gortyna micacea*).

1. Eggs in situ on stem.
2. Larva, side view, enlarged about two times.
3. Pupa, dorsal view, enlarged about two times.
4. Adult enlarged about four times.

that and the following year. In the fall the rhubarb was all taken up and the ground plowed and well cultivated. In 1916 it was planted to cabbage and cauliflowers. In 1917 there was no further appearance of the pest though the land was planted out to potatoes.

During the past summer more complaints reached the office regarding this insect than any other one pest. Never a mail arrived during its active season, that did not bring letters of specimens.

Frequent mention was made in the press regarding this "new potato bug" and accounts of its ravages, often exaggerated, gained wide circulation.

We did not have an opportunity of making any detailed study of the insect, but were able to secure the general outlines of its life history and to observe its injuries. The eggs are laid by the female moth during the latter part of August and in September. They are doubtless laid on various weeds, but we have only found them on couch grass (*Agropyrum repens*) where they are very difficult to detect. They are laid loosely and frequently in rather large numbers, attached to the stem, generally being partially surrounded by the leaf sheath. The eggs, which do not appear to have been noted by other workers, are a little less than one millimeter in diameter, circular in outline, faintly ribbed and slightly tinged with pink.

The larvæ emerge in June and bore a tiny entrance hole in the stem through the centre of which they bore, causing it to wilt and die. In the rhubarb they frequently bore through and through the crown of the plant, but in potatoes and corn they confine their attention to the stalk. The injury continues through the latter part of July and into the early part of August, when the insect transforms to a pupa, to emerge late in August or in September, as an adult moth.

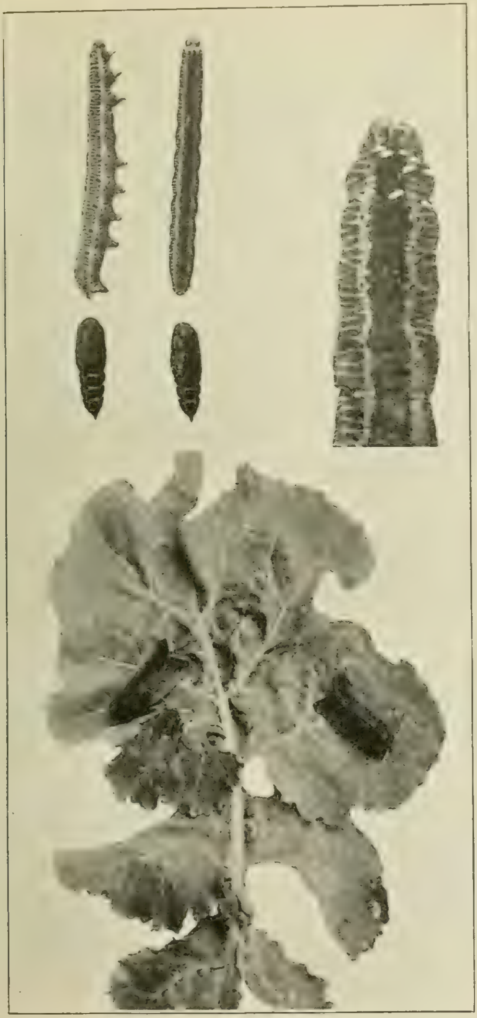
The unusually severe outbreak of this pest during the past year may have been partly due to the great increase in the number of back yard gardens, frequently planted in situations that had formerly been badly overgrown with weeds that would be likely to harbor the pest. The clean cultivation of the plantation during the oviposition period is an obvious step to take. In a permanent plantation, such as rhubarb, this is particularly necessary and in land that is planted continuously in garden crops. Gardens should not be planted on waste land that has been allowed to grow to weeds in previous seasons. Whenever possible such land should be thoroughly plowed and cultivated the previous fall in order to destroy as many eggs as possible. As the insect is chiefly a garden pest, picking the injured stalks and destroying the caterpillars is practicable and should be done to prevent outbreaks in future seasons. It is obviously impossible to attack the insects by means of insecticides.

The Zebra Caterpillar (*Ceramica picta* Harr.)

Unlike the former species, this is a native insect and occurs intermittently over a wide range in the United States and Canada. I have been able to locate about forty-five references to the work of the insect in American literature, consisting for the most part, of brief notes indicating that the pest is not considered to be one of major importance. Neither Chittenden or Sanderson mention it in their text books. O'Kane gives it a few lines stating that it feeds on garden crops of various sorts, especially beets, spinach, celery and peas.

It is apparent from the references to the insect in entomological literature that, while it cannot be considered an unusual pest, serious outbreaks are a somewhat rare occurrence, at least such outbreaks as have been experienced in the Annapolis Valley during the past two years.

1 2

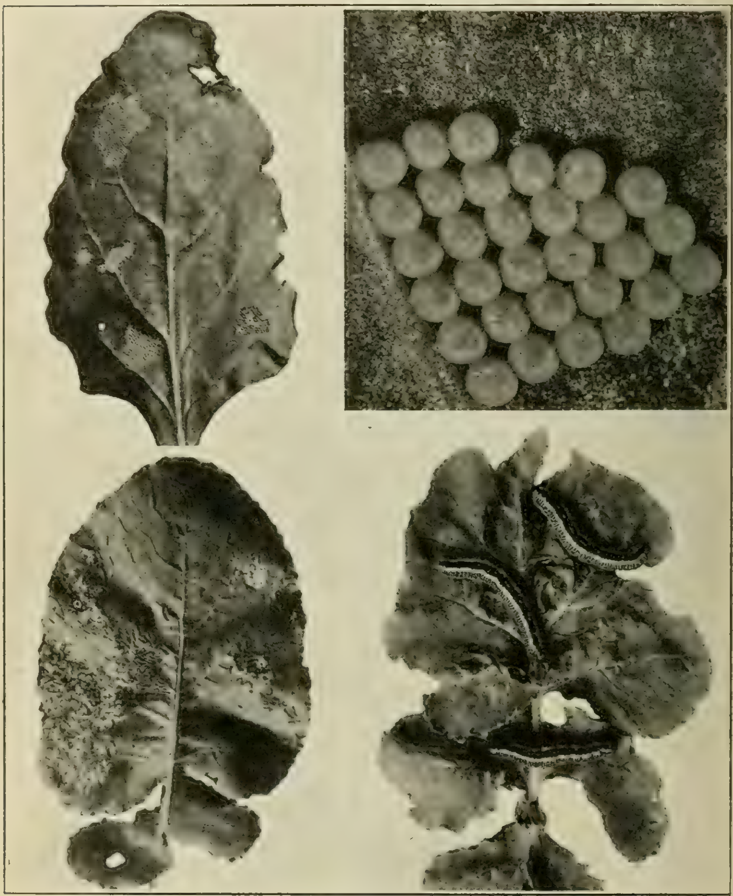


3

Zebra Caterpillar (*Ceramica picta*).

1. Larva, lateral and dorsal view, and pupa, ventral and dorsal view.
2. Larva with egg of tachina parasite near head. Enlarged.
3. Adults at rest on turnip leaf.

1 2



3 4

Zebra Caterpillar (*Ceramica picta*).

1. Turnip leaf with egg masses attached.
2. Eggs greatly enlarged.
3. Newy hatched larvæ on turnip leaf.
4. Mature larvæ on turnip leaf.

In 1915, Zebra caterpillars of the second brood were found to be quite common, though not particularly injurious, in the neighborhood of Kentville, but the next year was the first that any complaint regarding injury, was received. In 1916, there was a very serious outbreak in some localities, mostly in Kings County and numerous turnip fields were stripped of their leaves, the greater damage was being done, as usual, by caterpillars of the second brood. Full grown larvæ collected about Kentville in the fall, were found to be heavily parasited and it was thought that there was little danger of a serious outbreak the next year.

This proved to be true as far as the vicinity of Kentville was concerned, but further west in western Kings and Annapolis counties, and in parts of Digby and Yarmouth counties, there was an equally—if not a more severe outbreak, even the first brood caterpillars being fairly numerous and destructive in some cases. All the farmers, with scarcely an exception, stated that the insect was a new pest—one that they had never seen before. This does not necessarily indicate that the pest was a new one to our province and the nature and distribution of the outbreak would make this possibility extremely unlikely. It does indicate, however, that the period between outbreaks must be comparatively long.

Of the various crops attacked, turnip fields suffered most. Sometimes after the leaves were stripped, the caterpillars would attack the roots themselves and devour a sufficient amount to do considerable damage. On several occasions the larvæ were observed to migrate from one field to another after the manner of the army worm. This occurred when the particular crop upon which they were feeding was entirely devoured. Migrations were observed from turnips to grass and from buckwheat to potatoes.

The insects seem to be quite careless regarding their diet, feeding upon, in addition to those plants already mentioned, beets, mangolds, beans, hydrangeas, sweet peas, pigweed and even apple and plum trees. Eggs of the moth were found deposited on apple leaves twelve feet from the ground.

On a small scale and where cheap labor was available hand-picking the leaves bearing egg masses or nearly hatched caterpillars was the most economical remedy. Where this could not be done, dusting with powdered arsenicals applied by means of a blower, gave very satisfactory results.

THE ENTOMOLOGICAL RECORD, 1917.

Arthur Gibson, Chief Assistant Entomologist, Department of Agriculture, Ottawa.

Students of insects in Canada have again to acknowledge the many favours received from specialists in the United States and elsewhere for assistance in the determination of species. Dr. L. O. Howard and his colleagues, at Washington, have, as in the past, helped us very materially; Messrs. Barnes and McDunnough, have named many doubtful species of Lepidoptera; Messrs. Casey, Wickham, Liebeck, Leng, Fall, Frost, and Van Dyke have assisted in the Coleoptera; Messrs. Aldrich, Malloch, Johnson, Hine and M. C. Van Duzee, have determined Diptera, and Mr. J. H. Emerton has continued to examine spiders. All of these specialists, as well as others who have assisted us, have our sincere thanks.

Literature.

Among the books, memoirs, etc., (which have appeared during 1917) of interest to Canadian students the following may be mentioned:

Banks, Nathan. Index to the Literature of American Economic Entomology, January 1, 1905, to December 31, 1914: American Association of Economic Entomologists, Melrose Highlands, Mass. This most useful volume of 323 pages is a continuation of the Bibliography of Economic Entomology, which was published by the Bureau of Entomology, Washington, D.C. The insects and other headings are arranged alphabetically; under each are placed the references by author alphabetically.

Barnes William and McDunnough, J.H. Contributions to the Natural History of the Lepidoptera of North America; Vol. IV, No. 1. A Revision of the Genus *Hydriomena* Hbn., Decatur, Ill.: The Review Press, May 23, 1917, pp. 1-38, plates I-X. The results of this study are of particular interest to Canadian lepidopterists. The genus *Hydriomena* is one which has given much trouble and we are glad to have the results of this most recent study of these moths. A number of new species are described, and racial names given to several others. Four of these latter are from British Columbia, and one from Manitoba. Plates I to VI illustrate the various species, etc., many types being figured, and plates VII to X, illustrate male genitalia.

Bethune, C. J. S. Bibliography of Canadian Entomology for the year 1915: Trans. Royal Society of Can., Vol. X, Series III. 1916, pp. 169-187: separate received May 7, 1917. References are given to 175 papers: 71 of these relate to economic entomology; 12 to general entomology; 23 to lepidoptera: 13 to hymenoptera, etc.

Chagnon, G. A preliminary List of the Insects of the Province of Quebec, part III—Coleoptera; published as a supplement to the ninth annual report of the Quebec Society for the Protection of Plants: received Oct. 10, 1917. These lists are very useful. The list of coleoptera comprises 278 pages. Under each species, as in the two previous lists, the various known records are published. The author is to be congratulated on the completion of such a valuable list.

Funkhouser, W. D. Biology of the Membracidæ of the Cayuga Lake Basin; Cornell University Agric. Exp. Stn.; Memoir 11, June, 1917. This interesting memoir is the result of an extended biological study of the species found in the above district. It comprises pp. 181 to 445 and is illustrated with a number of figures and plates. Sixty-one species are discussed.

Garman, Philip. The Zygoptera, or Damsel Flies, of Illinois: Bulletin of the Illinois State Laboratory of Natural History. Article IV, June, 1917; pp. 411-586, plates LVIII-LXXII. Following valuable chapters on morphology, life-history and habits, and history of the Zygoptera, the classification of the species is dealt with. Generic and specific keys are given and descriptions of the nymphs and adults. The plates illustrate structural characters, etc.

Hebard, Morgan. The Blattidæ of North America north of the Mexican boundary: Philadelphia, Pa., Memoirs of the American Ent. Soc., No. 2, received Aug. 14, 1917; 284 pages, 10 plates. In this important contribution forty-three species are recorded as established within the United States and of these ten are probably introduced. Two indigenous forms and two established adventives are known to occur north of the Canadian boundary. Pages 259 to 274 deal more briefly with species found to be adventive but not established in portions of the United States and Canada.

Malloch, John R. A preliminary Classification of Diptera exclusive of Pupipara based on Larval and Pupal Characters, with keys to Imagines in certain Families; Part 1: Bulletin of the Illinois State Laboratory of Natural History, Vol. XII, Article III, March, 1917, pp. 161-409, plates XXVIII to LVII. This is indeed an important contribution and one which will be welcomed by both economic and taxonomic entomologists. The plates illustrate, chiefly, larval and pupal characters. The paper deals primarily with Illinois species.

Melander, A. L. and Spuler, Anthony. The Dipterous Families Sepsidæ and Piophilidæ: Bull. No. 143, April, 1917, Agric. Exp. Sta., Pullman, Wash. The species discussed in this paper are commonly combined as the family Sepsidæ. Economically they are principally scavengers, feeding and breeding in filth, sewage, etc. Descriptions of twenty new species and six new varieties are included. Four are from Canada. The plate at the end illustrates modifications of femora and tibiæ of various species.

Parker, John Bernard. A Revision of the Bembicine Wasps of America, north of Mexico: Proc. U.S.N.M., Vol. 53, pp. 1-55; published Feb. 10, 1917. This revision is based upon a study of the specimens in the United States National Museum and other important collections. A number of new species are described, only one of which, however, is from Canada. Interesting biological notes are given on pages 123-141. Eight plates showing structural characters are included.

Parshley, H. M. Fauna of New England, 14; List of the Hemiptera-Heteroptera: Occasional Papers of the Boston Society of Nat. History, VII, Aug., 1917. This useful list will be of special interest to Canadian hemipterists of Eastern Canada, as many of the species herein recorded will undoubtedly be found in Quebec and the Maritime Provinces. Four hundred and nineteen species are listed, definite localities and dates of collection being given.

Quaintance, A. L., and Baker, A. C. A contribution to our knowledge of the White Flies of the Subfamily Aleyrodinæ (Aleyrodidæ): Proc. U.S.N.M., Vol. 51, pp. 335-445, with plates 32-77; published January 20, 1917. This contribution is in continuance of Parts 1 and 2 of Bull. 27, Tech. Series, U.S. Bureau of Entomology. One new species is described from Canada.

Van Duzee, Edward P. Catalogue of the Hemiptera of America, north of Mexico, excepting the Aphididæ, Coccidæ, and Aleurodidæ; University of California Publications; Technical Bulletins; Entomology, Vol. 2, pp. 1-902, Nov. 30, 1917. This catalogue undertakes to give a complete enumeration of all the described Hemiptera to and including the Chermidæ, recorded from or known to occur in America north of the southern boundary of the United States. The families Aphididæ, Coccidæ and Aleurodidæ have been omitted, largely because of the fact that Mr. Van Duzee has made no careful study of these groups. The numbering of the species in the catalogue has been made to correspond with that in the Check List published in 1916, by the New York Entomological Society, species published since being interpolated in the catalogue in fractional form. Mr. Van Duzee has been a great help to Canadian hemipterists and we congratulate him on the completion of this most valuable catalogue.

Vierick, H. L., with the collaboration of A. D. MacGillivray, C. T. Brues, W. M. Wheeler and S. A. Rowher: State of Conn., Bull. 22, Geological and Natural History Survey; Part III, the Hymenoptera, or Wasp-like insects, of Connecticut. This most valuable part of the Guide to the Insects of Connecticut, prepared under the direction of Dr. W. E. Britton, was received in March, 1917. It is a large volume of 824 pages and 10 plates. Keys are included to families, sub-families, and species. Dr. Britton with the various authors are to be con-

gratulated on the completion of this work which will prove indispensable to students of insects generally. The purpose of the volume is primarily, as Dr. Britton states, to present a ready means for determining insects belonging to the hymenoptera, along with such cardinal facts as will leave no doubt as to the desirability of becoming familiar with the order as a whole, and more especially with those forms that are beneficial to us and the few kinds that we call injurious.

WHEELER, WILLIAM MORTON. The Mountain Ants of Western North America: Amer. Academy of Arts and Sciences, Vol. 52, No. 8. Jan., 1917, pp. 457-569. In this valuable contribution many Canadian records are included. One new species, three sub-species and three varieties are described from Western Canada.

NOTES OF CAPTURES.

(Species preceded by an asterisk (*) described during 1917.)

LEPIDOPTERA.

(Arranged according to Barnes and McDunnough's Check List of the Lepidoptera of North America.)

Papilionidæ.

6. *Papilio zelicaon* Luc. Nordegg, Alta., July 12-17, 1917, 6,500 feet, (K. Bowman and F. C. Whitehouse).

Pieridæ.

39. *Euchloe creusa* Dbldy. Nordegg, Alta., July 12, 1917, 6,500 feet, (K. Bowman and F. C. Whitehouse).

Satyridæ.

103. *Coenonympha inornata* Edw. Toronto, Ont., (H. S. Parish). Addition to Toronto list.

119. *Cercyonis oetus* Bdv. Nordegg, Alta., Aug. 10, 1916, 5,000 feet, (F. C. Whitehouse).

Nymphalidæ.

198. *Brenthis youngi* Holl. Klutlan Glacier, Yukon, 9,000 feet, June, 1913, (H. F. J. Lambart).

202. *Brenthis astarte* D. & H. Nordegg, Alta., July 14-16, 1917, 6,500 feet, (K. Bowman and F. C. Whitehouse).

Lycænidæ.

* *Lycæna lygdamus columbia* Skinner. "Vancouver"; Ent. News, XXVIII, 213.

Hesperiidæ.

488. *Hesperia centaureæ* Ramb. Nordegg, Alta., July 12, 1917, 6,500 feet, (K. Bowman and F. C. Whitehouse).

Sphingidæ.

671. *Dolba hylæus* Dru. Quyon, Que., Aug. 23, 1917, (J. I. Beaulne). Only one record in Winn's List of Quebec Lepidoptera, namely, "Dunham Co., VII, (Fyles)."

705. *Smerinthus jamaicensis geminatus* Say. Armstrong, B.C., July 12, 1915, (W. Downes). Only record we have for B.C.

706b. *Smerinthus cerisyi opthalmicus* form *pallidulus* Edw. Victoria, B.C., June 28, 1913, July 14, 1917, bred ex. pupa; new record for B.C.; have seen no other specimens in B.C. collections, (E. H. Blackmore).

Saturniidæ.

794. *Pseudohazis eglanterina* G. & R. Victoria, B.C., July 23, 1917; taken by a schoolboy on the outskirts of the city; first record for Victoria, (E. H. Blackmore).

Arctiidæ.

855. *Lexis bicolor* Grt. Pocahontas, Alta., Aug., 1916; Nordegg, Alta., July, 1917, (K. Bowman).

947. *Neoarctia yarrowi* Stretch. Nordegg, Alta., July 13-16, 6,500 feet, (K. Bowman and F. C. Whitehouse).

988. *Apantesis williamsi determinata* Neum. Murray Bay, Que., (J. G. Holmes). Previously recorded in Quebec Province from St. Agathe.

Noctuidæ.

1080. *Dysocnemis oregonica* Hy. Edw. Armstrong, B.C., May 5, 1907, (W. Downes).

1254. *Euxoa andera* Sm. Armstrong, B.C., July 10, 1915, (W. Downes).

1308. *Euxoa terrena* Sm. Victoria, B.C., Aug. 14, 1917, (E. H. Blackmore).

1313. *Euxoa ontario* Sm. Hymers, Ont. July 30, 1911, (H. Dawson).

1329. *Euxoa tessellata* Harr. Goldstream, B.C., Sept. 1, 1917, (E. H. Blackmore).

1332. *Euxoa esta* Sm. Goldstream, B.C., Sept. 1, 1917, one of the rarest Euxoas in the province, (E. H. Blackmore).

1438. *Agrotis rubifera* Grt. Armstrong, B.C., 1914, (W. Downes).

1475. *Epipsilia monochromatea* Morr. Bridgetown, N.S., May 26, 1914, (G. E. Sanders).

1561. *Abagrotis erratica* Sm. Victoria, B.C., Aug. 11, 1917, (E. H. Blackmore); first record from Vancouver Isl.; previously recorded from Kaslo, (J. W. Cockle) and has been taken at Okanagan Landing (J. A. Munro) and Armstrong (W. Downes)—E. H. B.

1628. *Anarta richardsoni* Curt. Kluthlan Glacier, Yukon, 9,000 feet, June, 1913, (H. F. J. Lambart).

1760. *Polia restora* Sm. Victoria, B.C., Aug. 19, 1916, (E. H. Blackmore); Aug. 25, 1916, (M. Brinkman).

1853. *Eriopyga infidelis* Dyar. Victoria, B.C., Aug. 14, 1917, (E. H. Blackmore).

1938. *Cirphis farcta* Grt. Armstrong, B.C., July 22, 1915, (W. Downes).

2168. *Graptolitha thaxteri* Grt. Montreal, Que., May 12, 1917, (A. F. Winn).

2177. *Xylotype capax* G. & R. Hymers, Ont., Sept. 15, 1911, (H. Dawson).

2178. *Eurotype confragosa acutissima* Grt. Murray Bay, Que., (J. G. Holmes). Addition to the Quebec list.

2187. *Eumichtis ducta* Grt. Smith's Cove, N.S., July 15, 1916, (C. A. Good).

2189. *Eumichtis miniota* Sm. Fort William, Ont., Aug. 19, 1907.

2254. *Septis antennata purpurissata* B. & McD. Victoria, B.C., July 25, 1916; July 21, 1917, (E. H. Blackmore).

2412. *Cerma cuerva* Barnes. Victoria, B.C., Aug. 25, 1916, (E. H. Blackmore). This species has previously been listed under the name of *olivacea* Sm.

Victoria is the only recorded locality in British Columbia for this species, which is rather rare, (E. H. B.).

2465. *Acronycta tritona* Hbn. Hymers, Ont., June 7, 1911, (H. Dawson).

2485. *Acronycta chionochroa* Hamp. Edmonton, Alta., May, 1910, (K. Bowman).

2489. *Acronycta innotata* Gn. Edmonton, Alta., June, 1916, (K. Bowman).

2613. *Menopsimus caducus* Dyar. Waubamic, Parry Sound, Ont., Aug. 4, 5, (H. S. Parish).

* *Xylomoia chagnoni* B. & McD. Rouville Co., Que., June 4; Mt. St. Hilaire, Que., July 4, 6, (G. Chagnon); Cartwright, Man., (E. F. Heath); Can. Ent. XLIX, 320.

2648. *Gortyna obliqua* Harv. Saanich, B.C., Sept. 22, 1916, (W. Downes).

3256. *Autographa nichollæ* Hamp. Rosedale, B.C., June 22, 1917, (E. H. Blackmore). This species occurs sparingly throughout the Lower Fraser Valley and has previously been listed under the name of *Euchalcia putnami* Grt., (E. H. B.).

3274. *Autographa ampla* Wlk. Victoria B.C., July 12, 1917, not previously recorded from this locality, (E. H. Blackmore).

3441. *Mycetophora inexplicata* Wlk. Waubamic, Parry Sound, Ont., July 12, (H. S. Parish); Edmonton, Alta., July 7, 1915, (D. Mackie).

Notodontidæ.

3596. *Datana angusii* G. & R. Jordan, Ont., June 30, 1916, (W. A. Ross).

Drepanidæ.

3757. *Oreta rosea* Wlk. Edmonton, Alta., July 12, 1916, (D. Mackie).

3758. *Oreta irrorata* Pack. Edmonton, Alta., July 12, 1916, (D. Mackie).

3761. *Drepana arcuata siculifer* Pack. Edmonton, Alta., June, 1916, (K. Bowman).

Geometridæ.

3862. *Acidalia frigidaria* Moesch. Edmonton, Alta., July 13, 1915, (D. Mackie).

3865. *Acidalia fuscata* Hlst. Edmonton, Alta., May 29, 1915, (D. Mackie).

3918. *Cosymbia lumenaria* Hbn. Rosedale, B.C., June 20, 1917, (E. H. Blackmore).

3981. *Lygris destinata lugubrata* Moesch. Montfort, Que., June 30, 1916, W. T. M. Forbes).

3982. *Lygris similis harveyata* Tayl. Edmonton, Alta., Aug., 1916, (K. Bowman).

3990. *Thera otisi* Dyar. Pocohontas, Alta., Aug., 1916, (K. Bowman). Mr. E. H. Blackmore, of Victoria, B.C., has informed me that the species recorded in last year's Record, under this name proves to be what he calls *Xanthorhoe incursata,* although it is rather doubtful if the insect is the real *incursata.*

* *Dysstroma mulleolata sobria* Swett. Victoria, B.C., June 22, 1914, (E. H. Blackmore); Can. Ent., XLIX, 69.

* *Dysstroma mulleolata subumbrata* Swett. Victoria, B.C., June 2, 14, 16, 22, 1914; June 24, 26, 1915, (E. H. Blackmore); Can. Ent. XLIX, 70.

* *Dysstroma mulleolata ochrofuscaria* Swett. Victoria, B.C., June 27, 1915, (E. H. Blackmore); Duncan, B.C., June 14, 1910, (A. W. Hanham); Duncan, B.C., Aug. 7, 1908, (G. O. Day); Vancouver Island, July 16, 1905; Can. Ent. XLIX, 70.

4014. *Hydriomena perfracta* Swett. Nordegg and Pocohontas, Alta., June-July, 1917, (K. Bowman). This, I understand, is now considered to be a distinct species and not a variety of *coerulata*.

* *Hydriomena exculpata tribulata* B. & McD. Kaslo, B.C.; Contr. Nat. Hist. Lep. N.A., IV, 14.

* *Hydriomena perfracta exasperata* B. & McD. Departure Bay, Van. Is., B.C., July 13, (G. W. Taylor); Wellington, B.C., June 23, (G. W. Taylor); Contr. Nat. Hist. Lep. N.A., IV, 19.

* *Hydriomena frigidata manitoba* B. & McD. Cartwright, Man., May 25, 28; Contr. Nat. Hist. Lep. N.A., IV, 17.

* *Hydriomena renunciata pernigrata* B. & McD. Skagit Basin, B.C.; Stickeen River, B.C.; Contr. Nat. Hist. Lep. N.A., IV, 25.

* *Hydriomena edenata grandis* B. & McD. Duncan, B.C., March 24-30; Victoria, B.C., April 8, 13, 16; Contr. Nat. Hist. Lep. N.A., IV, 33.

4042. *Xanthorhoe convallaria mephistaria* Swett. Goldstream, B.C., Sept. 3, 1917, (E. H. Blackmore).

4053. *Xanthorhoe congregata* Wlk. Edmonton, Alta., July 13, 1915, (D. Mackie).

4053. *Xanthorhoe salvata* Pears. Edmonton, Alta., July 18, 1915, (D. Mackie).

4092. *Epirrhoe alternata* Mull. Rosedale, B.C., June 22, 1917, (E. H. Blackmore).

4094. *Perizoma basaliata grandis* form *saawichata* Swett. Victoria, B.C., July 12, 1917, (E. H. Blackmore).

4115, 1. *Venusia obsoleta* Swett. Quamichan Lake, near Duncan, B.C., April 18, 1917, (G. O. Day).

4120. *Hydrelia albifera* Wlk. Rosedale, B.C., June 27, 1917. This is the farthest west record of this eastern species, Kaslo being the only other recorded locality in the Province, (E. H. Blackmore).

4158. *Eupithecia columbiata* Dyar. Edmonton, Alta., April 17, 1915, (D. Mackie).

4171. *Eupithecia casloata* Dyar. Rosedale, B.C., June 26, 1917, (E. H. Blackmore).

4218. *Eupithecia stellata* Hulst. Edmonton, Alta., July 23, 1915, (D. Mackie).

4226. *Eupithecia nevadata* Pack. Victoria, B.C., April 3, 1917, (E. H. Blackmore).

4243. *Eupithecia usurpata* Pears. Victoria, B.C., April 12, 1917, (E. H. Blackmore).

4323. *Drepanulatrix litaria* Hulst. Lillooet, B.C., Sept. 22, 1917, (A. W. A. Phair). This is the true *litaria* of which *fumosa* is a synonym. I also have it from Kaslo, B.C., (J. W. Cockle) and Ymir, B.C., (W. H. Danby). The species that Dr. Dyar listed in his Kootenay list as *litaria* is *falcataria* Pack., (E. H. Blackmore).

4332. *Philobia ulsterata* Pears. Cloverdale, B.C., July 9, 1917, (Bevan Hugh). This is one of the rarest of our B.C. geometers, the last previous record I have of this species is Vancouver, B.C., June 7, 1908, A. H. Bush, (E. H. Blackmore).

4341. *Macaria bicolorata* Fabr. Armstrong, B.C., 1913, (W. Downes).

4398. *Hesperumia sulphuraria* form *baltearia* Hulst. Armstrong, B.C., June, 1915, (W. Downes).

4407. *Itame brunneata* Thun. Montfort, Que., June 30, 1916, (W. T. M. Forbes). Addition to Quebec list.

4413. *Itame exauspicata* Wlk. Edmonton, Alta., July 18, 1915, (D. Mackie).

4429. *Itame hulstiaria* Tayl. Edmonton, Alta., May 22, 1915, (D. Mackie).

4478. *Plataea trilinearia* Pack. Lillooet, B.C., (A. W. A. Phair). This is an interesting record as the only previous recorded specimen for British Columbia was taken many years ago by Mr. H. Skinner, at Keremeos Creek, B.C., (E. H. Blackmore).

4488. *Nepytia semiclusaria pellucidaria* Pack. Lillooet, B.C., Sept. 22, 1917, (A. W. A. Phair); Armstrong, B.C., (W. Downes). New record for B.C., (E. H. Blackmore).

4553. *Cleora excelsaria* Stkr. Goldstream, B.C., June 3, 1917, at rest on the charred trunk of a pine tree, first specimen taken for over 12 years, (E. H. Blackmore).

4644. *Sicya macularia crocearia* Pack. Victoria, B.C., July 17, 1917; fairly common at night, has dimorphic females, (E. H. Blackmore).

* *Euchlaena albertanensis* Swett. Calgary, Alta., May 31, 1912, (F. H. Wolley-Dod); Edmonton, Alta., June 16, 1916, (K. Bowman); Edmonton, Alta., (D. Mackie); Can. Ent. XLIX, 351.

4711. *Selenia alciphearia ornata* B. & McD. Victoria, B.C., July 17, 1917, (E. H. Blackmore); Cloverdale, B.C., July 30, 1917, (Bevan Hugh).

4726. *Metanema quercivoraria* Gn. Cloverdale, B.C., June 28, 1917, (E. H. Blackmore); July 12, 1917, (Bevan Hugh).

Pyralidæ.

5098. *Phlyctænia acutella* Wlk. Waubamic, Parry Sound, Ont., July 15, 1916, (H. S. Parish).

5216. *Cataclysta magnificalis* Hbn. Waubamic, Parry Sound, Ont., July 12, (H. S. Parish).

5238. *Scoparia penumbralis* Dyar. Waubamic, Parry Sound, Ont., June 5, July 26, (H. S. Parish).

5254. *Pyralis costiferalis* Wlk. Waubamic, Parry Sound, Ont., July 12, (H. S. Parish).

* *Schœnobius amblyptepennis* Dyar. St. John's, Que., July 11, 1915, (W. Chagnon); Insecutor Inscitiæ Menstruus V, 80.

* *Schœnobius melinellus uniformellus* Dyar. St. Therese Island, Que., July 28, 1915, (W. Chagnon); St. John's Que., July 31, 1915, (W. Chagnon); Winnipeg, Man., (A. W. Hanham); Insecutor Inscitiæ Menstruus, V. 81.

* *Immyrla pasadamia* Dyar. St. John's Que., June 18, 1911, (W. Chagnon); Insecutor Inscitiæ Menstruus, V. 45.

Aegeriidæ.

6686. *Synanthedon corni* Hy. Edw. Waubamic, Parry Sound, Ont., July 12, (H. S. Parish).

Lyonetiidæ.

8135. *Bucculatrix pomifoliella* Clem. Hemmingford, Que., June 13, 1917, (C. E. Petch). Only one record, namely, "Montreal" in Winn's Quebec list.

Nepticulidæ.

* *Nepticula canadensis* Braun. Bear Creek, near Roger's Pass, B.C.; Trans. Amer. Ent. Soc., XLIII, 185.

Micropterygidæ.

8477. *Mnemonica auricyanea* Wlshm. Megantic, Que., July 6, Sherbrooke, Que.—Lake Park—July 5; Montfort, Que., June 30, 1916, (W. T. M. Forbes). Addition to Quebec list.

Hepialidæ.

8488. *Hepialus mathewi* Hy. Edw. Victoria, B.C., Sept. 23, 1917, (E. H. Blackmore). This species has stood under the name of *hyperboreus* Moesch. in B.C. collections for many years. It also occurs at Duncan, B.C., and Vancouver, B.C., (E. H. B.).

8493. *Hepialus montanus* Stretch. Victoria, B.C., May 3, 1915; June 20, 1916, (E. H. Blackmore).

Coleoptera.

(Arranged according to Henshaw's list of Coleoptera of America, North of Mexico.)

(Henshaw's number.)

Cicindelidæ.

36. *Cicindela cinctipennis* Lec. Red Deer. Alta., July 8. 1917, (P. A. Taverner and C. H. Young).

Carabidæ.

77. *Omophron tessellatum* Say. Lanoraie, Que.. June, July, 1915, (G. Beaulieu).

177. *Notiophilus semistriatus* Say. Miami, Man., June 28, 1916, (J. B. Wallis).

189. *Nebria gebleri* Dej. Lake Louise, Alta., Aug. 13, 1915, (J. B. Wallis).

231. *Dyschirius longulus* Lec. Husavick, Man., June 22, 1912; Winnipeg, Man., Aug. 16, 1916, (J. B. Wallis). New to Manitoba.

240. *Dyschirius erythrocerus* Lec. Miami, Man., July 6, 1914, (J. B. Wallis). New to Manitoba.

251. *Dyschirius pumilis* Dej. Aweme, Man., June 9, 1916. (N. Criddle). New to Manitoba.

254. *Dyschirius hispidus* Lec. Aweme. Man., June 9, 1916, (N. Criddle).

317. *Bembidium americanum* Dej. Husavick, Man., June 9, 1910. (J. B. Wallis). New to Manitoba.

374. *Bembidium approximatum* Lec. Weyburn. Sask.. June 18. 1916. (N. Criddle).

385. *Bembidium aneicolle* Lec. Winnipeg Beach. Man.. (J. B. Wallis).

388. *Bembidium intermedium* Kirby. Aweme. Man.. July 27. 1916. (N. Criddle).

391. *Bembidium versicolor* Lec. Estevan. Sask., May 21, 1916. (N. Criddle).

398. *Bembidium morulum* Lec. Aweme, Man., June 10. 1909. (E. Criddle). New to Manitoba.

412. *Bembidium connivens* Lec. Ogema. Sask.. June 16. 1916. (N. Criddle). New to Saskatchewan.

473. *Patrobus septentrionis* Dej. Gimli. Man.. July 19. 1916. (Frances Burridge). New to Manitoba.

Trechus borealis. Husavick, Man.. July 8. 1915. (J. B. Wallis). New to Manitoba.

671. *Amara farcta* Lec. Lethbridge, Alta., Aug. 23, 1912, (J. B. Wallis); Calgary, Alta., May 10, 1915, (W. H. T. Tams); Winnipeg, Man., May 3, 1912, (J. B. Wallis). New to Manitoba.

678. *Amara remotestriata* Dej. Lethbridge, Alta., Aug. 21, 1912, (J. B. Wallis); Bird's Hill, Man., Aug. 27, 1916, (J. B. Wallis). New to Manitoba.

898. *Lebia depicta* Horn. Winnipeg, Man., Oct. 4, 1912, (J. B. Wallis). New to Manitoba.

906. *Dromius piceus* Dej. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

1087c. *Harpalus erythropus* Dej. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

Haliplidæ.

Peltodytes sexmaculatus Robts. Bird's Hill, Man., Aug. 27, 1916, (J. B. Wallis); Miami, Man., Oct. 9, 1916, (J. B. Wallis). New to Manitoba.

Dytiscidæ.

* *Laccophilus inconspicuous* Fall. Winnipeg, Man., June 3, 1911, (J. B. Wallis); Edmonton, Alta., (F. S. Carr); Montreal, Que.; Jour. N.Y. Ent. Soc., XXV, 164.

1296. *Coelambus masculinus* Cr. Thornhill, Man., July 1, 1916, (J. B. Wallis); Winnipeg, Man., Sept. 23, 1916, (J. B. Wallis). New to Manitoba.

1298. *Coelambus unguicularis* Cr. Winnipeg, Man., May 11, 1912; Sept. 2, 1916, (J. B. Wallis). New to Manitoba.

1314. *Hydroporus undulatus* Say. Winnipeg, Man., Aug. 16, 1916, (J. B. Wallis). New to Manitoba.

1430. *Agabus congener* Payk. Winnipeg, Man., June 20, 1915, (J. B. Wallis).

1458. *Rhantus flavogriseus* Cr. Winnipeg, Man., Sept. 2, 1916, (J. B. Wallis). New to Manitoba.

Gyrinidæ.

1524. *Gyrinus pectoralis* Lec. Onah, Man., May 24, 1912, (J. B. Wallis); Winnipeg, Man., June 6, 1911, (J. B. Wallis). New to Manitoba.

Hydrophilidæ.

1582. *Hydræna pennsylvanica* Kies. Aweme, Man., July 21, 1903, (N. Criddle). New to Manitoba.

1590. *Tropisternus mixtus* Lec. Selkirk, Man., Sept. 23, 1911, (J. B. Wallis); Winnipeg, Man., Aug. 16, 1916, (J. B. Wallis). New to Manitoba.

1672. *Cercyon melanocephalum* Linn. Aweme, Man., July 4, 1910, (N. Criddle). New to Manitoba.

Pselaphidæ.

1875. *Tyrus humeralis* Aube. Aweme, Man., (N. Criddle).

Staphylinidæ.

2092. *Acylophorus pronus* Er. Husavick, Man., June 22, 1912, (J. B. Wallis).

2106. *Quedius lævigatus* Gyll. Aweme, Man., July 19, 1917, (N. Criddle).

Quedius curtipennis Csy. Aweme, Man., June 27; Sept. 6, 1917, (N. Criddle).

2128. *Staphylinus erythropterus* Linn. Aweme, Man., (N. Criddle).

2189. *Philonthus hudsonicus* Horn. Husavick, Man., June 22, 1912, (J. B. Wallis).

Philonthus protervus Csy. Winnipeg, Man., June 24, 1912, (J. B. Wallis). New to Manitoba.

2204. *Philonthus sordidus* Grav. Peachland, B.C., July 19, 1912, (J. B. Wallis); Winnipeg, Man., May 13, 1911, (J. B. Wallis). New to Manitoba.

2213. *Philonthus brevipennis* Horn. Aweme, Man., June 27; Sept. 6, 1917, (N. Criddle).

2220. *Philonthus punctatellus* Horn. Winnipeg, Man., May 6, 1912, (J. B. Wallis). New to Manitoba.

2221. *Philonthus nigritulus* Grav. Winnipeg, Man., May 30, 1912; Husavick, Man., June 23, 1912, (J. B. Wallis). New to Manitoba.

2251. *Actobius pæderoides* Lec. Winnipeg, Man., April 29, 1911, (J. B. Wallis).

2268. *Xantholinus cephalus* Say. Peachland, B.C., July 19, 1912; Winnipeg, Man., May 18, 1912; Miami, Man., July 2, 1914, (J. B. Wallis). New to Manitoba.

2319. *Stenus femoratus* Say. Onah, Man., May 24, 1912, (J. B. Wallis). New to Manitoba.

2355. *Stenus corvus* Csy. Winnipeg, Man., June 6, 1916, (J. B. Wallis). New to Manitoba.

2358. *Stenus alpicola* Fauv. Husavick, Man., June 22, 1912, (J. B. Wallis). New to Manitoba.

2377. *Stenus humilis* Er. Onah, Man., May 24, 1912, (J. B. Wallis).

2389. *Stenus vinnulus* Csy. Onah, Man., May 24, 1912, (J. B. Wallis).

Platymedon laticollis Csy. Aweme, Man., May 2, 1916, (N. Criddle). New to Manitoba.

Lathrobium obtusum Csy. Onah, Man., May 24, 1912, (J. B. Wallis). New to Manitoba.

2512. *Lathrobium punctulatum* Lec. Husavick, Man., July 3, 1910; Winnipeg, Man., Sept. 18, 1912, (J. B. Wallis). New to Manitoba.

2514. *Lathrobium nigrum* Lec. Husavick, Man., Aug., 1914, (J. B. Wallis). New to Manitoba.

2525. *Lathrobium concolor* Lec. Winnipeg, Man., April 17, 1911; Onah, Man., May 24, 1912, (J. B. Wallis). New to Manitoba.

2526. *Lathrobium simplex* Lec. Onah, Man., May 24, 1912, (J. B. Wallis). New to Manitoba.

2548. *Pycnorus (Scopæus) dentiger* Lec. Stony Mountain, Man., April 21, 1916, (J. B. Wallis). New to Manitoba.

2557. *Stilicus biarmatus* Lec. Winnipeg, Man., May 18, 1912, (J. B. Wallis). New to Manitoba.

2562. *Lithocharis obsoleta* Nordm. Onah, Man., May 24, 1912, (J. B. Wallis). New to Manitoba. Col. Casey refers this to *Pseudomedon thoracicum* Csy., saying that *obsoleta* does not occur in N. A. (H.C.F.)

2578. *Sunius prolixus* Er. Winnipeg, Man., May 13, 1911, (J. B. Wallis). New to Manitoba.

2580. *Sunius brevipennis* Aust. Aweme, Man., June 19, 1917, (N. Criddle).

2626. *Tachinus pallipes* Grav. Winnipeg, Man., May 14, 1912, (J. B. Wallis). New to Manitoba.

2751. *Oxytelus niger* Lec. Winnipeg, Man., April 23, 1916, (J. B. Wallis). New to Manitoba.

9715. *Oxytelus suspectus* Csy. Winnipeg, Man., May 13, 1911; Onah, Man., May 24, 1912, (J. B. Wallis).
2805. *Acidota crenata* Fab. Husavick, Man., July 15, 1912, (J. B. Wallis). New to Manitoba.
2831. *Olophrum rotundicolle* Sahlb. Husavick, Man., June 22, 1913, (J. B. Wallis).
2840. *Homalium lapponicum* Zett. Winnipeg, Man., June 1, 1912, (J. B. Wallis). New to Manitoba.
2851. *Homalium hamatum* Fauv. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

Scaphidiidæ.
2978. *Bæocera concolor* Fab. Aweme, Man., June 27, (N. Criddle).

Phalacridæ.
Phalacrus probatus Csy. Winnipeg, Man., May 13, 1911; Miami, Man., June 27, 1916; Husavick, Man., (J. B. Wallis).

Corylophidæ.
3011. *Sacium lugubre* Lec. Aweme, Man., May 3, 1903, (N. Criddle).
3024. *Gronevus* (*Corylophus*) *truncatus* Lec. Onah, Man., May 24, 1912; in moss in larch swamp, (J. B. Wallis). New to Manitoba.
3025. *Sericoderus flavidus* Lec. Aweme, Man., May 4, 1917; in swarms of *Formica fusca*, (N. Criddle).

Coccinellidæ.
3069. *Harmonia picta* var. *hudsonica*. Victoria Beach, Man., Aug. 7, 1916, (J. B. Wallis). New to Manitoba.
3162. *Scymnus punctatus* Melsh. Aweme, Man., Aug. 7, 1917, (N. Criddle); Thornhill, Man., July 5, 1916, (J. B. Wallis). New to Manitoba.

Endomychidæ.
3179. *Phymaphora pulchella* Newn. Bird's Hill, Man., Sept. 24, 1917, in fungus, (N. Criddle).
3186. *Aphorista vittata* Fab. Aweme, Man., July 7, 1916, (N. Criddle). New to Manitoba.

Cucujidæ.
3327. *Lamophlœus adustus* Lec. Aweme, Man., May 8, 1912, (E. Criddle).
3328. *Lamophlœus testaceus* Fab. Aweme, Man., June 9, 1916, (N. Criddle). New to Manitoba.

Cryptophagidæ.
Agathengis pumilio Csy. Miami, Man., June 26, 1916, (J. B. Wallis); Winnipeg, Man., May 14, (L. H. Roberts).
3380. *Coenoscelis ferruginea* Sahlb. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.
9926. *Atomaria apicalis* Er. Aweme, Man., May 11, 1912, (N. Criddle). New to Manitoba.
3388. *Atomaria ochracea* Zimm. Aweme, Man., July 4, 1916, (N. Criddle).
3389. *Atomaria ephippiata* Zimm. Aweme, Man., April 15, 1905, (N. Criddle).

Mycetophagidæ.
3406. *Litargus tetraspilotus* Lec. Aweme, Man., July 20, 1917, (N. Criddle); Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

3407. *Litargus didesmus* Say. Aweme, Man., June 22, 1910, (N. Criddle). New to Manitoba.

Histeridæ.

3461. *Hololepta fossularis* Say. Dunstan, Man., June 26, 1916, (Miss Jessie Duncan). New to Manitoba.
3464. *Hister planipes* Lec. Winnipeg, Man., June 20, 1915, (L. H. Roberts). New to Manitoba.
3495. *Hister furtivus* Lec. Thornhill, Man., July 5, 1916, (J. B. Wallis). New to Manitoba.
3551. *Dendrophilus punctulatus* Say. Miami, Man., July 4, 1914; Winnipeg, Man., May 31, 1915, (J. B. Wallis). New to Manitoba.
3571. *Saprinus rotundatus* var. *communis* Mars. Winnipeg, Man., June 10, 1914; Onah, Man., July 9, 1916, (J. B. Wallis). New to Manitoba.
3586. *Saprinus oregonensis* var. *sejunctus* Mars. Thornhill, Man., July 1, 1916, (J. B. Wallis). New to Manitoba.
3618. *Saprinus mancus* Say. Victoria Beach, Man., Aug. 7, 1916, (J. B. Wallis). New to Manitoba.

Nitidulidæ.

3711. *Epuraa ovata* Horn. Aweme, Man., Sept. 10, 1916, (N. Criddle).
3730. *Soronia undulata* Say. Aweme, Man., June 16, 1917, (N. Criddle).
3760. *Ips cylindricus* Lec. Aweme, Man., Oct. 24; June 24, 1906-11, (E. & N. Criddle).

Latridiidæ.

9990. *Corticaria fulva* Com. Winnipeg, Man., May 10, 1916, (J. B. Wallis). New to Manitoba.
3779. *Stephostethus liratus* Lec. Winnipeg, Man., Aug. 2, 1916, (J. B. Wallis). New to Manitoba.

Enicmus mimus Fall. Aweme, Man., May 2, 1905, (N. Criddle). New to Manitoba.

Enicmus aterrimus Mots. var *nitens*. Winnipeg, Man., June 10, 1916, on raspberry leaves, (J. B. Wallis).

Cartodere costulata Reitt. Winnipeg, Man., June 24, 1914; Sept. 16, in cellar, (J. B. Wallis).

3796. *Coninomus constrictus* Gyll. Winnipeg, Man., Sept. 14, Oct. 31, 1916; in cellar, (J. B. Wallis). New to Manitoba.

Trogositidæ.

3843. *Tenebrioides americana* Kirby. Ironside, Que., April 19, 1917, (L. M. Stöhr).
3890. *Byrrhus cyclophorus* Kirby. Winnipeg, Man., June 20, 26, 1915, (L. H. Roberts). Previously recorded by Hamilton from Hudson Bay.
3898. *Syncalypta echinata* Lec. Victoria Beach, Man., Aug. 7, 1916; under board on sandy beach, (J. B. Wallis). Previously taken by Hanham, at Brandon, Man.

Parnidæ.

3925. *Elmis vittatus* Melsh. Winnipeg, Man., July 19, 1916, (J. B. Wallis). New to Manitoba.
3930. *Elmis fastiditus* Lec. Aweme, Man., Aug. 28, 1907; in river under stones, (N. Criddle).

3951. *Stenelmis vittipennis* Zimm. Aweme, Man., Aug. 28, 1917; in river under stones, (N. Criddle).

Heteroceridæ.

Heterocerus schwarzi Horn. Aweme, Man., Sept. 3, 1917; in mud, (N. Criddle).

3965. *Heterocerus collaris* Kies. Aweme, Man., Sept. 3, 1917; in mud, (N. Criddle).

3969. *Heterocerus pusillus* Say. Aweme, Man., Sept. 3, 1917; in mud, (N. Criddle).

Dascyllidæ.

3993. *Eucinetus terminalis* Lec. Winnipeg, Man., April 27, 1916, (J. B. Wallis).

Elateridæ.

4153. *Hypnoidus* (*Cryptohypnus*) *tumescens* Lec. Winnipeg, Man., June 13, 1914, (Wallis). New to Manitoba.

4220. *Elater pullus* Germ. Husavick, Man., July 6, 1915, (J. B. Wallis). New to Manitoba.

4223. *Elater discoideus* Fab. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

4271. *Ludius attenuatus* Say. Meach Lake, Que., June 21, 1916, (A. Gibson). Addition to Quebec list.

4286. *Agriotes pubescens* Melsh. Headingly, Man., June 13, 1916, (J. B. Wallis).

4380. *Campylus denticornis* Kirby. Aweme, Man., June 22, 1912, (E. Criddle).

4455. *Corymbites angularis* Lec. Vancouver, B.C., May 28, 1915, (R. N. Chrystal).

4456. *Corymbites medianus* Germ. Berens River, Man., July 18, 1916, (Misses Gordon & Lepage).

4487. *Corymbites splendens* Ziegl. Winnipeg, Man., June 13, 1914, (J. B. Wallis).

4495. *Corymbites metallicus* Payk. Onah, Man., July 7, 1916, (J. B. Wallis).

4499. *Oxygonus obesus* Say. Winnipeg, Man., June 4, (L. H. Roberts). New to Manitoba.

Hemicrepidius (*Asaphes*) *brevicollis* Cand. Winnipeg, Man., Aug. 1, 1916, (J. B. Wallis).

Buprestidæ.

Dicerca caudata Lec. Victoria Beach, Man., June 17, 1916, (J. B. Wallis). New to Manitoba.

4738. *Agrilus acutipennis* Mann. Thornhill, Man., June 30, 1916, (J. B. Wallis). New to Manitoba.

4742. *Agrilus politus* var. *corylus*. Darlingford, Man., June 10, 1915, (W. R. Metcalfe). New to Manitoba.

4746a. *Agrilus cephalicus* Lec. Onah, Man., July 9, 1916, (J. B. Wallis). New to Manitoba.

Cleridæ.

5178. *Clerus spegeus* Fab. Peachland, B.C., April 28, 1916, (F. Elliott).

5210. *Phyllobænus dislocatus* Say. Aweme, Man., July 2, 1911, (N. Criddle). New to Manitoba.

Ptinidæ.

5329. *Caenocara scymnoides* Lec. Aweme, Man., June 7, 1912, (N. Criddle).
Caenocara bicolor Germ. Miami, Man., June 26, 1916, (J. B. Wallis).
Ptilinus pruinosa Csy. Darlingford, Man., July 17, 1916; issuing from dry aspen logs in stable, (W. R. Metcalfe).

Cioidæ.

Octotemnus laevis Csy. Bird's Hill, Man., Sept. 24, 1917, in fungus, (N. Criddle).
5389. *Cis fuscipes* Mellié. Aweme, Man., May 29, 1905, (N. Criddle).
Bracycis brevicollis Csy. Aweme, Man., April 6, 1917, in birch bracket fungus, (E. Criddle).
5404. *Ennearthron thoracicornis* Ziegl. Aweme, Man., Sept. 6, Oct. 10, 1917, in fungus, (N. Criddle).
Xestocis levettei Csy. Aweme, Man., April 23, 1916, (N. Criddle). New to Manitoba.

Sphindidæ.

5410. *Eurysphindus hirtus* Lec. Aweme, Man., (N. Criddle).

Scarabæidæ.

5552. *Aphodius brevicollis* Lec. Darlingford, Man., Oct. 10, 1915, (W. R. Metcalfe). New to Manitoba.

Cerambycidæ.

6179. *Xylotrechus colonus* Fab. Darlingford, Man., July 7, 1915, (W. R. Metcalfe).
6180. *Xylotrechus sagittatus* Germ. Victoria Beach, Man., July 7, 1916, (J. B. Wallis). New to Manitoba.
6253. *Anthophilax malachiticus* Hald. Chelsea, Que., May 28, 1917, (L. M. Stöhr).
6279. *Bellamira scalaris* Say. Hemmingford, Que., Aug. 4, 1917, (C. E. Petch).
6316. *Leptura subargentata* Kirby. Aweme, Man., July 4, 1909, (N. Criddle).
6514. *Tetraopes quinquemaculatus* Hald. Onah, Man., Aug. 26, 1910, (J. B. Wallis).

Chrysomelidæ.

6573. *Lemna trilineata* Oliv. Onah, Man., July 9, 1916, (J. B. Wallis).
6632. *Cryptocephalus insertus* Hald. Stony Mountain, Man., July 31, 1916, (J. B. Wallis). New to Manitoba.
Pachybrachys praeclaris Weise. Aweme, Man., Sept. 10, 1916, (E. Criddle). New to Manitoba.
Pachybrachys carbonarius var. *janus* Fall. Aweme, Man., July 26, 1912, (E. Criddle). New to Manitoba.
Pachybrachis autolycus var. *wahsatchensis* Fall. Aweme, Man., June 24, July 7, 1908-12, (E. Criddle). New to Manitoba.
6681. *Pachybrachys obsoletus* Suffr. Thornhill, Man., June 30; Onah, Man., July 9, 1916, (J. B. Wallis). New to Manitoba.
6690. *Pachybrachys atomarius* Melsh. Thornhill, Man., July 11, 1916; previous records for Manitoba under this name were *peccans*, (Wallis).
Pachybrachys relictus Fall. Darlingford, Man., July 11, 1915, (W. R. Metcalfe).. New to Manitoba.
6712. *Diachus catarius* Suffr. Winnipeg, Man., June 1, 17, 1916, (J. B. Wallis). New to Manitoba.

6789. *Leptinotarsa (Doryphora) decemlineata* Say. Red Deer, Alta., 4 adults, Oct. 1, 1917; also reported from Calgary, Alta., (F. C. Whitehouse).

Calligrapha rhoda Knab. Bird's Hill, Man., Aug. 27, 1916, (J. B. Wallis). New to Manitoba.

Calligrapha rowena Knab. Miami, Man., June 20, 1916, (J. B. Wallis). New to Manitoba.

6891a. *Diabrotica fossata* Lec. Aweme, Man., July 29, 1917, (E. Criddle).

6932. *Oedionychis vians* Ill. Ogema, Sask., June 16, 1916, (N. Criddle); Spirit River, Alta., Aug. 20, 1916, (E. H. Strickland).

6932a. *Oedionychis scripticollis* Say. Calgary, Alta., May 10, 1915; Winnipeg, Man., April 24, 1916, (J. B. Wallis). New to Manitoba.

10421. *Haltica vicaria* Horn. Onah, Man., July 7, 1916, (J. B. Wallis). New to Manitoba.

10458. *Phyllotreta pusilla* Horn. Aweme, Man., Sept. 23, 1916, (N. Criddle). New to Manitoba.

7031. *Phyllotreta robusta* Lec. Ogema, Sask., May 29, 1916, (N. Criddle).

10462. *Chætocnema opulenta* Horn. Aweme, Man., June 21, 1917, (N. Criddle).

7053. *Chætocnema pulicaria* Cr. Winnipeg, Man., June 10, 1916, (J. B. Wallis). New to Manitoba.

Tenebrionidæ.

Paratenetus crinitus Fall. Aweme, Man., Sept. 25, 1916, (N. Criddle). New to Manitoba.

Pythidæ.

7713. *Priognathus monilicornis* Rand. Aweme, Man., May 24, 1914, (N. Criddle). New to Manitoba.

Mordellidæ.

7803. *Mordellistena biplagiata* Helm. Miami, Man., June 28, 1916, (J. B. Wallis); Aweme, Man., June 11, 1916, (N. Criddle). New to Manitoba.

Mordellistena cervicalis Lec. Aweme, Man., Sept. 7, 1916, (N. Criddle). New to Manitoba.

7839. *Mordellistena pustulata* Melsh. Darlingford, Man., July 4, 1915, (W. R. Metcalfe); Miami, Man., June 26, 1916, (J. B. Wallis); Husavick, Man., July 26, 1916, (L. H. Roberts). New to Manitoba.

Anthicidæ.

7945. *Anthicus floralis* Linn. Stony Mountain, Man., July 31, 1916, (J. B. Wallis). New to Manitoba.

7956. *Anthicus ephippium* Laf. Husavick, Man., July 24, 26, 1916, (L. H. Roberts). New to Manitoba.

7976. *Anthicus pallens* Lec. Gimli, Man., July 19, 1916, (Frances M. Burridge). New to Manitoba.

Pyrochroidæ.

7993. *Schizotus cervicalis* Newm. Aweme, Man., July 9, 1916, (N. Criddle).

Meloidæ.

8069. *Macrobasis segmentata* Say. Darlingford, Man., June 13, 1915, (W. R. Metcalfe). New to Manitoba.

Rhipiphoridæ.

8171. *Pelecotoma flavipes* Melsh. Darlingford, Man., July 17, 1916; emerging at the same time and place as *P. pruinosus* but from dry peeled aspen

poles, *pruinosus* preferring the larger logs, (W. R. Metcalfe); Aweme, Man., July 26, 1906, (E. Criddle).

Curculionidæ.

Apion huron Fall. Aweme, Man., July 3, 1917, (N. Criddle).
8381. *Apion pennsylvanicum* Boh. Aweme, Man., July 3, 1917, (N. Criddle).
8405. *Apion walshii* Smith. Aweme, Man., Aug. 3, 1917, (N. Criddle).
8419. *Apion tenuirostrum* Smith. Aweme, Man., July 6, 1917, (N. Criddle).
8482. *Hypomolyx piceus* DeG. Montreal, Que., (J. H. Menard).
8625. *Magdalis armicollis* Say. Aweme, Man., Aug. 30, 1916, (E. Criddle).
8661. *Pseudanthonomus cratægi* Walsh. Hemmingford, Que., July 31, 1917, (C. E. Petch); only one record, namely, "Montreal Isl." in Quebec list.
11030. *Chelonychus longipes* Dietz. Aweme, Man., Aug. 7, 1917, (E. Criddle).
11041. *Orchestes parvicollis* Lec. Aweme, Man., July 3, 1917, (N. Criddle).
Ceutorhynchus oregonensis Dietz. Aweme, Man., (N. Criddle).
Cryptorhynchus lapathi L. Roberval, Lake St. John, Que., July, 1915, (G. Beaulieu).
8832. *Cœliodes nebulosis* Lec. Aweme, Man., (N. Criddle).
* *Ceutorhynchus omissus* Fall. Aweme, Man., Sept. 23, (N. Criddle); Can. Ent. XLIX, 388.
* *Ceutorhynchus echinatus* Fall. Aweme, Man., Sept. 25, (N. Criddle); Can. Ent., XLIX, 387.
* *Ceutorhynchus invitus* Fall. Aweme, Man., Sept. 23, (N. Criddle); Can. Ent., XLIX, 388.
Ceutorhynchus neglectus Blat. Aweme, Man., July 20, 1917, (N. Criddle).
* *Ceutorhynchus convexipennis* Fall. Aweme, Man., May 31, 1909, (E. Criddle); Aweme, Man., Sept. 8, (N. Criddle); Can. Ent. XLIX, 390.
8863. *Rhinoncus pericarpius* Linn. Aweme, Man., Aug. 7, 1917, (E. Criddle).
11102. *Baris inconspicua* Csy. Aweme, Man., July 9, 1916, (N. Criddle). New to Manitoba.

Ipidæ.

* *Crypturgus borealis* Sw. Winnipeg, Man., (J. B. Wallis); found westward to the coast and south to Colorado, in species of *Picea;* Bull. 14, Ent. Br., Dom. Dept. Agr., p. 7.
* *Phlœosinus canadense* Sw. Ste. Anne de Bellevue, Que., in *Thuya occidentalis*—the species of eastern Canada heretofore confused with *P. dendatus* Say; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 8.
* *Pseudohylesinus tsugæ* Sw. Stanley Park, Vancouver, B.C., in *Tsuga heterophylla*, widely distributed along the B. C. coast; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 11.
* *Pseudohylesinus sitchensis* Sw. Menzies Bay, B.C.; Port Renfrew, B.C., and Stanley Park, Vancouver, B.C.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 12.
* *Pseudohylesinus grandis* Sw. Bull. 14, Ent. Br., Dom. Dept. Agr., p. 13. Mr. Swaine informs me that the types are from Saanichton, B.C.
* *Pseudohylesinus obesus* Sw. Inverness, B.C.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 15.
* *Lesperisinus cinereus* Sw. Hudson, Que., Bull. 14, Ent. Br., Dom. Dept. Agr., p. 15.
9163. *Leperisinus aculeatus* Say. Miami, Man., June 28, 1916, (J. B. Wallis). New to Manitoba.

* *Carphoborus carri* Sw. Edmonton, Alta., in *Picea canadensis*, (F. S. Carr); Aweme, Man., (N. Criddle); Bull. 14, Ent. Br., Dom. Dept. Agr., p. 16.

* *Hylurgops lecontei* Sw. "British Columbia;" Bull. 14, Ent. Br., Dom. Dept. Agr., p. 16.

* *Pseudocryphalus brittaini* Sw. Salmon Arm, B.C., (W. H. Brittain); Bull. 14, Ent. Br., Dom. Dept. Agr., p. 20.

* *Pseudocryphalus criddlei* Sw. Aweme, Man., (N. Criddle); Bull. 14, Ent. Br., Dom. Dept. Agr., p. 21.

* *Trypodendron borealis* Sw. Athabasca Landing, Alta.; Prince Albert, Alta., also "northern Saskatchewan;" Bull. 14, Ent. Br., Dom. Dept. Agr., p. 21.

* *Trypodendron ponderosæ* Sw. "Southern coast and interior of British Columbia;" Bull. 14, Ent. Br., Dom. Dept. Agr., p. 22.

* *Anisandrus populi* Sw. Ste. Anne de Bellevue, Que.; in region about Montreal Island and in the Ottawa valley; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 22.

* *Xyleborus canadensis* Sw. Isle Perrot, Que., Aug. 29, 1910; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 24.

* *Pityophthorus canadensis* Sw. "In twigs of *Pinus* in Ontario and Quebec;" Bull. 14, Ent. Br., Dom. Dept. Agr., p. 24.

* *Pityophthorus nitidus* Sw. Tullochgoram, Que.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 25.

* *Pityophthorus rhois* Sw. "Throughout the eastern parts of the United States and Canada;" Bull. 14, Ent. Br., Dom. Dept. Agr., p. 26.

* *Pityophthorus confertus* Sw. Adams Lake, B.C., (Tom Wilson); Bull. 14, Ent. Br., Dom. Dept. Agr., p. 27.

* *Pityophthorus granulatus* Sw. Manitoba, Quebec and Nova Scotia; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 28.

* *Pityophthorus ramiperda* Sw. Isle Perrot, Que.; Ste. Anne de Bellevue, Que.; Stoney Creek, Ont.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 28.

* *Pityophthorus intextus* Sw. Athabasca Landing and northern Alberta, and north-eastern British Columbia; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 29.

* *Pityophthorus nudus* Sw. Ontario and Quebec; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 30.

* *Ips englemanni* Sw. Central British Columbia and Alberta; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 30.

* *Ips yohoensis* Sw. Yoho Valley, B.C.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 31.

Ips borealis Sw. Husavick, Man., July 13, 1915, (J. B. Wallis).

* *Eccoptogaster tsugæ* Sw. Cherry Creek Valley, B.C.; Glacier, B.C.; Jasper Park, Alta.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 32.

* *Eccoptogaster monticolæ* Sw. Arrowhead, B.C.; Creighton Valley, B.C.; Bull. 14, Ent. Br., Dom. Dept. Agr., p. 32.

Anthribidæ.

9207. *Allandrus bifasciata* Lec. Aweme, Man., Sept. 10, 1916, (E. Criddle). New to Manitoba.

DIPTERA.

(Arranged according to a Catalogue of North American Diptera, by J. M. Aldrich, Smithsonian Misc. Coll. XLVI, No. 1444. The numbers refer to the pages in the catalogue.)

Tipulidæ.

78. *Discobola argus* Say. St. Hilaire, Que., June 22, 1916, (W. T. M. Forbes). Addition to Quebec list.

81. *Elephantomyia westwoodi* O.S. Megantic, Que., July 6, 1916, (W. T. M. Forbes). First definite record from Quebec Province.

86. *Helobia hybrida.* Lake Park, near Sherbrooke, Que., July 5, 1916, (W. T. M. Forbes).

89. *Limnophila areolata* O.S. Megantic, Que., July 6, 7, 1916, (W. T. M. Forbes). Addition to Quebec list.

90. *Limnophila toxoneura* O.S. Lake Park, near Sherbrooke, Que., July 5, 1916, (W. T. M. Forbes). Addition to Quebec list.

* *Tricyphona autumnalis* Alex. Meach Lake, Que., Sept. 2, 1903, (J. Fletcher); Rostrevor, Ont., (not Quebec as in description), Sept. 2, 1907, (A. Gibson); Can. Ent. XLIX, 30.

93. *Amalopis calcar* O.S. In the Entomological Record for 1913, we recorded this species from Meach Lake, Que., and Rostrevor, Ont. On further study Mr. Alexander described the specimens, under the name *Tricyphona autumnalis*, in the Can. Ent. XLIX, 30. A note to this effect should be made in the 1913 Record and also in the Quebec List of Diptera by Winn and Beaulieu, published in 1915.

94. *Cylindrotoma splendens* Doane. Westholme, Van. Isl., B.C., May 17, 1917, (A. E. Cameron). New to Canada.

101. *Tipula caloptera* Loew. St. Hilaire, Que., June 27, 1916, (W. T. M. Forbes). Addition to Quebec list.

Tipula monticola Alex. Ottawa, Ont., June 18, 1916, (W. T. M. Forbes).

105. *Tipula umbrosa* Loew. Megantic, Que., July 6, 1916, (W. T. M. Forbes). Addition to Quebec list.

Culicidæ.

* *Aedes mimensis* Dyar. Kaslo, B.C.; Aweme, Man., June 13, July 10, (N. Criddle); Insecutor Inscitiæ Menstruus, V. 116.

* *Aedes prodotes* Dyar. Banff, Alta., 1908, (N. B. Sanson); Insecutor Inscitiæ Menstruus, V. 118.

* *Aedes acrophilus* Dyar. Lake Louise, Laggan, Alta., Aug. 18, 1916, (Dyar and Caudell); Insecutor Inscitiæ Menstruus, V, 127.

Simulidiidæ.

169. *Prosimulium hirtipes* Fr. Victoria, Vanc. Isl., B.C., April 15, (A. E. Cameron).

Stratiomyidæ.

179. *Sargus nubeculosus* Zett. Outremont, Que., Aug. 30, 1917; Joliette, Que., July 8, 1917, (C. J. Ouellette). Addition to Quebec list.

Nemotelus bonnarius Jhn. Aweme, Man., Aug. 24, 1916, (N. Criddle). First record for Manitoba.

Tabanidæ.

202. *Tabanus cinctus* Fab. Ironside, Que., July 20, 1916, (L. M. Stöhr). Addition to Quebec list.

203. *Tabanus fratellus* Will. Banff, Alta., Aug. 10, 1915, (N. B. Sanson).
206. *Tabanus procyon* O. S. Goldstream, near Victoria, B.C., (E. H. Blackmore); North Bend, B.C., June 6, (S. Hadwen). These are the only records we have for Canada.

Leptidæ.

215. *Leptis ochracea* Loew. Montreal, Que., June 27. 1917, (C. J. Ouellette). Addition to Quebec list.

Bombyliidæ.

232. *Anthrax lateralis* Say. Ironside, Que., Aug., 1916, (L. M. Stöhr).
236. *Bombylius validus* Loew. Ironside, Que., June 14, 1916, (L. M. Stöhr).
238. *Ploas nigripennis* Loew. Goldstream, near Victoria, B.C., July 4, 1916, (E. H. Blackmore).

Asilidæ.

Leptogaster virgatus Coq. St. Eustache, Que., Aug. 22, 1917, (C. J. Ouellette). Dr. Aldrich, who determined the specimen reported, "I believe new to Canada; at least I find no published record."
260. *Cyrtopogon nebulo* O.S. Victoria, B.C., June 5, 10, 16, 1916, (R. C. Treherne).
272. *Laphria pubescens* Will. Banff, Alta., Aug. 11, 1916, (N. B. Sanson).
273. *Laphria xanthippe* Will. Banff, Alta., June 23, 1914, (N. B. Sanson).

Dolichopodidæ.

* *Sympycnus canadensis* Van Duzee. Fort Erie, Ont., June 6; Can. Ent., XLIX, 339.
297. *Scellus exustus* Walk. St. Eustache, Que., Aug. 18, 1917, (C. J. Ouellette). Addition to Quebec list.
299. *Dolichopus batillifer* Loew. Joliette, Que., July 10, 1917, (C. J. Ouellette). Addition to Quebec list.

Phoridæ.

337. *Aphiochæta rufipes* Mg. Banff, Alta., June 21, 1915, (N. B. Sanson).

Syrphidæ.

346. *Microdon globosus* Fab. Joliette, Que., July 15, (C. J. Ouellette). This appears to be the only definite record which we have for Quebec Province.
346. *Microdon tristis* Loew. Ironside, Que., July 20, 1916, (L. M. Stöhr).
353. *Chilosia occidentalis* Will. Lillooet, B.C., 8,000 feet, (A. W. A. Phair).
362. *Leucozona lucorum* L. Ironside, Que., June 17, 1916, (L. M. Stöhr). Previously recorded from Quebec Province from Levis.
Syrphus rectus O. S. Mount Royal, Que., (C. J. Ouellette). Addition to Quebec list. This was considered a synonym of *ribesii* until lately, when Shannon revived it—Proc. Biol. Soc. Wash., 1916, 201—J. M. A.
375. *Rhingia nasica* Say. Aweme, Man., Aug. 21, 1916, (N. Criddle).
375. *Hammerschmidtia ferruginea* Fallen. Ironside, Que., May 31, 1916, (L. M. Stöhr). Addition to Quebec list.
383. *Pyritis montigena* Hunter. Victoria, B.C., April 12, 1917, (A. E. Cameron).
Eumerus strigatus Fall. Montreal, Que., in a greenhouse, Feb. 5, 1917, (J. I. Beaulne). Addition to Quebec list.

396. *Pterallastes perfidiosus* Hunter. Ironside, Que., May 11, 1916, (L. M. Stöhr). Addition to Quebec list.

400. *Chrysochlamys croesus* O. S. Victoria, B.C., June 6, 1916, (R. C. Treherne).

400. *Chrysochlamys dives* O. S. Aweme, Man., July 7, 1916, (N. Criddle).

401. *Brachypalpus frontosus* Loew. Ironside, Que., June 7, 1916, (L. M. Stöhr).

401. *Crioprora alopex* O. S. Victoria, B.C., April 19-30, 1913, (E. H. Blackmore).

402. *Criorhina armillata* O. S. Lillooet, B.C., (A. W. A. Phair).

Tachinidæ.

438. *Leucostoma atra* Twns. St. Eustache, Que., Aug. 10, 1917, (C. J. Ouellette). Addition to Quebec list.

459. *Exorista spinipennis* Coq. Ironside, Que., (L. M. Stöhr). Addition to Quebec list.

476. *Metopia leucocephala* Rossi. Joliette, Que., July 20, 1917; St. Eustache, Que., Aug. 15, 1917, (C. J. Ouellette). Addition to Quebec list.

Sarcophagidæ.

Sarcophaga atlanis Ald. Outremont, Que., Aug. 28, 1917, (C. J. Ouellette). New to Canada.

511. *Sarcophaga cimbicis* Twns. Mt. Royal, Que., Aug. 2, 1917, (C. J. Ouellette). Addition to Quebec list.

Sarcophaga hæmorrhoidalis Mg. Outremont, Que., Sept. 17, 1917, (C. J. Ouellette). Addition to Quebec list.

512. *Sarcophaga hunteri* Hgh. St. Eustache, Que., Aug. 17, 1917, (C. J. Ouellette). New to Canada.

Sarcophaga latisetosa Park. St. Eustache, Que., Aug. 20, 1917, (C. J. Ouellette). Addition to Quebec list.

513. *Sarcophaga pallinervis* Thorn., (*communis* Park). St. Eustache, Que., Aug. 18, 1917; Mt. Royal, Que., Aug. 29, 1917, (C. J. Ouellette). Addition to Quebec list.

Sarcophaga sinuata Mg. St. Eustache, Que., Aug. 18, 1917; Outremont, Que., June 28, 1917, (C. J. Ouellette). Addition to Quebec list.

Muscidæ.

522. *Lucilia sericata* Mg. Outremont, Que., Sept. 10, 1917; Aug. 28, 1917, (C. J. Ouellette). Addition to Quebec list.

523. *Lucilia sylvarum* Mg. St. Eustache, Que., Aug. 18, 1917; Joliette, Que., July 10, 1917; Outremont, Que., Aug. 30, 1917, (C. J. Ouellette). Addition to Quebec list.

Anthomyidæ.

Paralimnophora brunneisquama Mall. Joliette, Que., July 15, (C. J. Ouellette).

545. *Spilogaster nitens* Stein. Dr. Aldrich in a letter October 12, 1917, informs us that in examining the Hough collection at the Univ. of Chicago, he discovered that the type of this species is from Toronto, Ont., not Massachusetts as Stein's paper gives it. He also remarks that he found the species to be a true *Pogonomyia* and that it has since been described by Malloch as *Pogonomyia flavinervis*.

Scatophagidæ.

Spathiophora fascipes Beck. St. Eustache, Que., Aug. 18, 1917, (C. J. Ouellette). Not hitherto reported from Canada. Dr. Aldrich who

determined the specimen states (in litt. Nov. 26, 1917), "*S. fascipes* Becker is a European species that has been found in North America in but two places before that I know of—Hine collected it in some numbers at Cedar Point, near Sandusky, Ohio, and it was identified for him by Coquillett, and I have a specimen from South Haven, Mich." The species was described in Berliner Ent. Zeitsch, XXXIII, 160, 1889.

Sciomyzidæ.

579. *Tetanocera pallida* Loew. Aweme, Man., July 18, 1916, (N. Criddle).
580. *Tetanocera saratogensis* Fitch. Aweme, Man., July 18, 1916, (N. Criddle).
581. *Sepedon armipes* Loew. St. Eustache, Que., Aug. 18, 1917; Mt. Royal Que., Sept. 20, 1917, (J. Ouellet). Mr. Beaulieu has taken the species at Ottawa, Ont.

Sapromyzidæ.

Lonchæa vaginalis Fall. Outremont, Que., Aug. 28, 1917, (C. J. Ouellette). New to Canada.

586. *Sapromyza notata* Fall. Aweme, Man., July 18, 1916, (N. Criddle).

Ortalidæ.

589. *Rivellia flavimanus* Loew. Aweme, Man., July 13, 1916, (N. Criddle).
589. *Rivellia viridulans* Desv. Mt. Royal, Que., June 30, 1917; Joliette, Que., July 20, 1917, (J. Ouellet). Addition to Quebec list.
591. *Tephronota canadensis* Jns. Aweme, Man., July 13, 1916, (N. Criddle).

Stenomyia fasciapennis Cr. Aweme, Man., June 13, 1916, (N. Criddle). Described from Minnesota.

Trypetidæ.

606. *Rhagoletis pomonella* Walsh. Royal Oak, Victoria, Vanc. Isl., B.C., Aug. 15, 1917, (W. Downes).
609. *Eurosta comma* Wied. Maryfield, Sask., Aug. 31, 1916, (N. Criddle).
612. *Euaresta æqualis* Loew. St. Eustache, Que., Aug. 22, 1917, (C. J. Ouellette). Addition to Quebec list.

Sepsidæ.

* *Sepsis violacea hecati* Melan. & Spuler. Keremeos, B.C., (A. L. Melander); Bull. 143, Wash. Agr. Exp. Stn., p. 22.

* *Sepsis signifer* Melan. & Spuler. Nelson, B.C., (A. L. Melander); Bull. 143, Wash. Agr. Exp. Sta., p. 26.

* *Sepsis signifer curvitibia* Melan. & Spuler. Nelson, B.C., (A. L. Melander); Bull. 143, Wash. Agr. Exp. Stn., p. 28.

* *Sepsis neocynipsea* Melan. & Spuler. Waubamic, Parry Sound, Ont., (H. S. Parish); Bull. 143, Wash. Agr. Exp. Stn., p. 29.

* *Themira malformans* Melan. & Spuler. Hudson Bay; Bull. 143, Wash. Agr. Exp. Stn., p. 46.

Ephydridæ.

* *Notiphila olivacea* Cr. Toronto, Ont., July 4, 1913, (M. C. Van Duzee); Trans. Amer. Ent. Soc., XLIII, 52.

628. *Ochthera mantis* DeG. Ironside, Que., April 19, 1912, (L. M. Stöhr). Addition to Quebec list.

Oscinidæ.

Chlorops certima Adams. Aweme, Man., Aug. 24, 1916, (N. Criddle).

633. *Diplotoxa pulchripes* Loew. Ogema, Sask., June 16, 1916, (N. Criddle).

634. *Diplotoxa recurva* Adams. Aweme, Man., Aug. 12, 1916; Maryfield, Sask., (N. Criddle).

634. *Chloropisca variceps* Loew. Aweme, Man., Aug. 24, 1917, (N. Criddle).

635. *Epichlorops exilis* Coq. Aweme, Man., July 30, Aug. 11, 1917, (N. Criddle).

Elachiptera aliena Beck. Aweme, Man., Sept. 11, 1916, (N. Criddle). New to Canada.

636. *Elachiptera eunota* Loew. Aweme, Man., Aug. 24, 1916, (N. Criddle).

Elachiptera planicollis Beck. Aweme, Man., Aug. 24, Sept. 18, 1916, swept from sedges, (N. Criddle).

Oscinis infesta Beck. Aweme, Man., Aug. 24, 1916, (N. Criddle). New to Canada.

Oscinis sulfurihalterata End. Aweme, Man., July 21, Aug. 12, (N. Criddle).

Geomyzidæ.

Diastata 10-guttata Walk. Aweme, Man., Sept. 4, 1916, (N. Criddle).

Agromyzidæ.

Agromyza quadrisetosa Mall. Ogema, Sask., June 16, 1916, (N. Criddle).

Agromyza subangulata Mall. Aweme, Man., May 28, 1916, (N. Criddle).

Agromyza laterella Zett. Aweme, Man., July 18, 1916, (N. Criddle).

648. *Agromyza longipennis* Loew. Aweme, Man., July 29, 1916, (N. Criddle).

Pseudodinia nitida Mall. Aweme, Man., July 18, 29, 1916, (N. Criddle).

HYMENOPTERA.

Tenthredinidæ.

* *Emphytus mellipes albolabris* Rohwer. Departure Bay, Vanc. Isl., B.C., July 5, 1913, (E. M. Walker); Proc. U.S.N.M., 53, 152.

Braconidæ.

* *Wesmaelia americana* Myers. "Ottawa, Can."; Proc. U.S.N.M., 53, 293.

* *Bracon montrealensis* Morr. Montreal, Que.; Proc. U.S.N.M., 52, 326.

Ichneumonidæ.

* *Pseuderipternus brevicauda* Cushman. "Canada"; Proc. U.S.N.M., 53, 506.

Euceros cooperii Cr. Aweme, Man., July 6, 1917, (N. Criddle).

* *Bathythrix tibialis* Cushman. Vancouver, B.C.; Proc. U.S.N.M., 53, 458.

Pteromalidæ.

* *Eupteromalus tachinæ* Gahan. Guelph, Ont., (A. W. Baker); Proc. U.S.N.M., 53, 211.

Chalcididæ.

* *Lamprostatus canadensis* Girault. Banff, Alta., (E. A. Schwarz); Psyche, XXIV, 96.

Formicidæ.

* *Leptothorax muscorum* var. *septentrionalis* Wheeler. Banff, Alta., (C. G. Hewitt); Emerald Lake, B.C., (W. M. Wheeler); Proc. Amer. Acad. Sc., 52, 511.

* *Leptothorax emersoni* subsp. *hirtipilis* Wheeler. Banff, Alta.; Proc. Amer. Acad. Sc., 52, 515.
* *Lasius flavus* subsp. *claripennis* Wheeler. Banff, Alta.; Proc. Amer. Acad. Sc., 52, 527.
* *Formica fusca* subsp. *pruinosa* Wheeler. Emerald Lake, B.C., Aug. 12-15; Field, B.C.; Banff, Alta.; (W. M. Wheeler); Proc. Amer. Acad. Sc., 52, 548.
* *Formica hewitti* Wheeler. Emerald Lake, B.C.; Field, B.C., Laggan, Alta., (W. M. Wheeler); Proc. Amer. Acad. Sc., 52, 552.
* *Formica truncicola integra* var. *subcaviceps* Wheeler. Dog Lake, Penticton, B.C., (C. G. Hewitt); Proc. Amer. Acad. Sc., 52, 540.
* *Polyergus rufescens* subsp. *breviceps* var. *fusciventris* Wheeler. Treesbank, Man., (C. G. Hewitt); Proc. Amer Acad. Sc., 52, 555.

Eumenidæ.

* *Eumenes crassicornis* Isely. Goldstream, B.C.; Annals Ent. Soc. Amer., X, 362.

Vespidæ.

Vespa austriaca Pz. Ironside, Que., June 18, 1916, two females, (L. M. Stöhr).

Sphecidæ.

Thyreopus argus Pack. Chelsea, Que., July, 1917, males, (L. M. Stöhr).

Thyreopus cingulatus Pack. Aweme, Man., July 21, 1914, male, female, (N. Criddle).

Crabro vierecki H. S. Smith. Lethbridge, Alta.: Nelson, B.C., July, 1916, (F. W. L. Sladen).

Cerceris rufinoda crucis Vier. & Ckll. Not "*crucia*" as in Ent. Rec. for 1917.

Bembicidæ.

* *Bembix comata* Parker. Vancouver, B.C.: Proc. U.S.N.M., 52, 100.

Anthophoridæ.

Anthophora simillima Cr. Lillooet, B.C., May 14, 1916, (E. M. Anderson); Invermere, B.C., April 25, 1915, (G. E. Parham).

Anthophora pacifica Cr. Victoria, B.C., April 25, 1916, (R. C. Treherne).

Anthophora peritomæ Ckll. Lethbridge, Alta., July 22, 1916; Medicine Hat, Alta., August 20, 1917, (F. W. L. Sladen).

* *Tetralonia hirsutissima* Ckll. British Columbia; Ann. Mag. Nat. Hist., June, 1916, p. 428.

Megachilidæ.

Chelynia rubi Ckll. Not "*rubri*" as in Ent. Record for 1917.

Megachile parallela Smith. Not "*parallela* Ckll." as in Ent. Record for 1917.

Megachile (*Xanthosarus*) *perihirta* Ckll. Cochrane, Ont., Aug. 9, 1917; nesting gregariously in a nearly new, bare, gravel railway embankment (F. W. L. Sladen); Athabasca, Alta., Aug. 12, 1915, (E. H. Strickland); this species was found in large numbers actively tripping the flowers of alfalfa at Keremeos, B.C., and Summerland, B.C., in July, 1917. The Athabasca and Cochrane females are darker than the British Columbia specimens, having much black hair on the sixth dorsal segment. (F. W. L. S.).

Bombidæ.

Bombus kirbyellus Frank. Banff, Alta., Aug., 1916, (N. B. Sanson).

Bombus polaris Frank. Banff, Alta., Aug., 1916, (N. B. Sanson).

HEMIPTERA.

(Arranged according to a Check List of the Hemiptera—excepting the Aphididæ, Aleurodidæ and Coccidæ—of America, north of Mexico, by E. P. Van Duzee; New York Entomological Society, 1916.)

Aphididæ.

Hamamelistes spinosus Shimer. Vineland, Ont., June 22, 1914, on *Betula papyrifera,* (W. A. Ross).

Euceraphis betulæ Koch. Bowmanville, Ont., July 21, 1913, (W. A. Ross).

Drepanosiphum platanoides Schr. Guelph, Ont., June 20, 1915, on maple, (W. A. Ross).

Myzocallis bellus Walsh. Ottawa, Ont., Sept. 4, 1917, on *Quercus,* (C. B. Hutchings).

Myzocallis asclepiadis Monell. Ottawa, Ont., Sept. 1, 1917, on milkweed, (C. B. Hutchings).

Nectarosiphum rubicola Oestlund. Bowmanville, Ont., 1913, (W. A. Ross); Ottawa, Ont., July 26, 1917, (C. G. Hewitt).

Macrosiphum tiliæ Monell. Vineland, Ont., Sept. 6, 1917, on basswood, (W. A. Ross).

Rhopalosiphum berberidis Kalt. Bowmanville, Ont., June 17, 1913, on barberry, (W. A. Ross).

Myzus (Ovatus) mespili v.d.G. Vineland Station, Ont., June 8, 1917, on *Pyrus japonica,* (W. A. Ross).

Aleyrodidæ.

* *Aleuroplatus berbericolus* Q. & B. Kaslo, B.C., Jan. 27, 1908, on *Berberis aquifolium,* (J. W. Cockle); Proc. U.S.N.M., 51, 383.

Pentatomidæ.

139. *Cœnus delius* Say. Covey Hill, Que., May 31, 1914, (C. E. Petch).

Aradidæ.

361. *Aradus quadrilineatus* Say. Ironside, Que., (L. M. Stöhr).

Tingididæ.

665. *Physatocheila plexa* Say. Ironside, Que., (L. M. Stöhr).

Miridæ.

1109. *Dicyphus famelicus* Uhl. Ironside, Que., April 18, 1917, (L. M. Stöhr).

* *Lygus vanduzeei* Knight. Parry Sound, Ont., July and August; (H. S. Parish); Truro, N.S., July 8, Sept. 19, Oct. 11; Kentville, N.S., July 2, Aug. 6, 10, Sept. 24, Oct. 5; Smith's Cove, N.S., July 15, Sept. 14, (W. H. Brittain): Cornell Univer. Agric. Exp. St., Bull. 391, 565.

* *Lygus vanduzeei* var. *rubroclarus* Knight. Saguenay River, Que.; Smith's Cove, N.S., May 8 to June 6, June 23, July 15; Kentville, N.S., June 24, Sept. 24, (W. H. Brittain); Cornell Univ. Agr. Exp. St., Bull. 391, 567.

* *Lygus humeralis* Knight. Bear Lake, B.C., July 20; Ainsworth, B.C., July 2; Revelstoke, B.C., July 1 5, (J. C. Bradley); Cornell Univ. Agric. Exp. St., Bull. 391, 570.

* *Lygus columbiensis* Knight. Fry Creek, B.C., July 23; Cornell Univ. Agr. Exp. St., Bull. 391, 371.
* *Lygus rubicundus* var. *winnipegensis* Knight. Winnipeg, Man., May 7, 1910, (J. B. Wallis); Cornell Univ. Agr. Exp. St., Bull. 391, 591.
* *Lygus alni* Knight. Wolfville, N.S.; Cornell Univ. Agric. Exp. St., Bull. 391, 608.
* *Lygus tiliæ* Knight. Ottawa, Ont., June 29: Cornell Univ. Agric. Exp. St., Bull. 391, 613.
* *Lygus omnivagus* Knight. Parry Sound, Ont., July 24, Aug. 7, (H. S. Parish); Cornell Univ. Agric. Exp. St., 391, 627.
* *Lygus canadensis* Knight. Parry Sound, Ont., July 10, (H. S. Parish); Cornell Univ. Agric. Exp. St., 391, 634.
* *Lygus ostryæ* Knight. Parry Sound, Ont., Aug. 6-8, (H. S. Parish); Cornell Univ. Agri. Exp. St., Bull. 391, 635.

Fulgoridæ.

2466. *Scolops sulcipes* Say. Hemmingford, Que., June 24, 1916, (C. E. Petch).
2549. *Cixius stigmatus* Say. Hemmingford, Que., July 9, 1917, (C. E. Petch).

Odonata.

(Arranged according to Muttkowski's Catalogue of the Odonata of North America. The numbers refer to the pages in the catalogue.)

Coenagrionidæ.

37. *Lestes congener* Hagen. St. Andrews, N.B., Sept. 16, 1917, (A. G. Huntsman).
37. *Lestes disjunctus* Selys. Dingwall, Aspy Bay, C.B., July 27, 1917, (A. G. Huntsman): Le Pas, Man., July 29, 1917; M. 214, H. B. Ry., Man., July 24, 1917, (J. B. Wallis).
39. *Lestes uncatus* Kirby. Neil's Harbour, C.B., July 29, 1917, (A. G. Huntsman).
55. *Enallagma calverti* Morse. Vancouver, B.C., June 14, July 1, 1917, (E. H. Blackmore).
56. *Enallagma civile* (Hagen). Plateau River, Cheticamp, C.B., July 27-Aug. 4, 1917, (A. G. Huntsman). New to Nova Scotia list.
56. *Enallagma clausum* Morse. Dauphin Lake, Man., July-August, 1917, (Mrs. W. W. Hippisley). New to Canada.
57. *Enallagma cyathigerum* (Charp.) Chilcotin, B.C., June 25, 1915, (W. A. N.); Cranbrook Dist., B.C., May 17, 1915; Le Pas, Man., July 7, 1917, (J. B. Wallis).
59. *Enallagma ebrium* (Hagen). Le Pas, Man., July 29, 1917, (J. B. Wallis).
60. *Enallagma hageni* (Walsh.). Dingwall, Aspy Bay, C.B., July 27, 1917, (A. G. Huntsman).
65. *Nehalennia irene* Hagen. Red Deer, Alta., July 1-8, (F. C. Whitehouse). New to Alberta list.

Coenagrion angulatum E. M. Walker. Le Pas, Man., July 1, 1917, (J. B. Wallis).

66. *Coenagrion interrogatum* (Selys.). Nordegg, Alta., July 19, (F. C. Whitehouse). New to Alberta and most westerly record. M. 332, H. B. Ry., July 17, 1917; M. 256, H. B. Ry., Man., July 12, 1917, (J. B. Wallis). New to Manitoba.

66. *Coenagrion resolutum* (Hagen). Le Pas, Man., July 1, 1917; M. 214, H. B. Ry., Man., July 8, 24, 27, 1917; M. 332, H. B. Ry., Man., July 17, (J. B. Wallis); Chilcotin, B.C., June 25, 1915, (W. A. N.). First British Columbia record.

66. *Amphiagrion saucium* (Burm.). Banff, Alta., July 2, 1913, (E. M. Walker).

Aeshnidæ.

76. *Cordulegaster diastatops* (Selys.) De Grassi Point, Ont., June 12, 1917, June 21, 1917, (E. M. Walker).

77. *Cordulegaster maculatus* Selys. De Grassi Point., Ont., June 19-24, 1917, (E. M. Walker); Algonquin Park, Ont., July 17, 1917, (E. M. Walker).

84. *Ophiogomphus colubrinus* Selys. M. 332 and 334, N. B. Ry., Man., July 20, 1917, (J. B. Wallis). New to Manitoba.

91. *Gomphus cornutus* Tough. Carlsbad Springs, Ont., June 20, 1908, (C. H. Young).

109. *Aeshna canadensis* E. M. Walker. Dingwall, Aspy Bay, C.B., July 27, 1917, (A. G. Huntsman).

Aeshna caerulea septentrionalis Burm. Hopedale, Labrador, Aug. 1917, (W. W. Perrett).

110. *Aeshna eremita* Scudd. Dingwall, Aspy Bay, C.B., July 27, 1917, (A. G. Huntsman).

111. *Aeshna interrupta interrupta* E. M. Walker. Dingwall, Aspy Bay, C.B., July 27, 1917, (A. G. Huntsman).

111. *Aeshna juncea* (Linn.) Hopedale, Labrador, Aug. 1917, (W. W. Perrett).

114. *Aeshna sitchensis* Hagen. Hopedale, Labrador, Aug. 1917, (W. W. Perrett); Amherst Id., Magdalen Islands, Que., July 15, 1917, (A. G. Hunstman).

114. *Aeshna subarctica* E. M. Walker. Amherst Id., Magdalen Islands, Que., July 15, 1917, (A. G. Huntsman).

114. *Aeshna umbrosa occidentalis* E. M. Walker. Prospect Lake, B.C., Aug. 30, 1917, (W. Downes).

Libellulidæ.

128. *Williamsonia lintneri* (Hagen). Mer Bleue, near Ottawa, Ont., May 25, 1908, June 4, 1908, (C. H. Young). New to Ontario list.

128. *Cordulia shurtleffi* Scudd. De Grassi Point, Ont., June 14, 1917, (E. M. Walker).

129. *Somatochlora albicincta* (Burm.). Nordegg, Alta., July 12-19, 1917, 4,000-6,500 feet; also nymph believed to be this on circumstantial evidence, previously unknown, (F. C. Whitehouse); Nain, Labrador, Aug. 13, 1917, Aug. 20, (Simon); Hopedale, Labrador, Aug. 1917, (W. W. Perrett).

129. *Somatochlora cingulata* (Selys). Nordegg, Alta., July 15, 17, 1917, 6,500 feet, (F. C. Whitehouse). New to Alberta list. M. 256, H. B. Ry., Man., July 12, 1917; M. 332, H. B. Ry., Man., July 16, 1917, (J. B. Wallis). New to Manitoba list.

130. *Somatochlora forcipata* (Scudd). Hopedale, Labrador, Aug. 1917, (W. W. Perrett). New to Labrador.

130. *Somatochlora franklini* (Selys.). Nordegg, Alta., 6,500 feet, July 11-17, 1917, (F. C. Whitehouse). New to Alberta list. Hopedale, Labrador.

Aug. 1917, (W. W. Perrett); Le Pas, Man., July 1, 1917, M. 214, H. B. Ry., Man., July 7-9, 1917; M. 332, July 14-19, 1917; M. 256, July 12, 1917, (J. B. Wallis).

131. *Somatochlora hudsonica* (Hagen). Sucker River, Thunder Bay District, Ont., July 21, 1917, (Mrs. G. K. Jennings). New to Ontario list. Red Deer, Alta., July 1-9, 1916: July 1, 1917; Nordegg, Alta., July 19, 1917, (F. C. Whitehouse).

131. *Somatochlora minor* Calvert. M. 256, H. B. Ry., Man., July 12, 1917, (J. B. Wallis); De Grassi Point, Ont., (E. M. Walker); Nordegg, Alta., July 11-18, 1917, 4,000-6,500 feet, (F. C. Whitehouse). New to Alberta list.

132. *Somatochlora semicircularis* (Selys.). Nordegg, Alta., July 16, 1917, (F. C. Whitehouse).

132. *Somatochlora septentrionalis* Hagen. Hopedale, Labrador, Aug., 1917, (W. W. Perrett); M. 332, H. B. Ry., Man., July 19, 1917, (J. B. Wallis). New to Manitoba list. Nordegg, Alta., July 18, 1917, 4,000 feet, (F. C. Whitehouse). New to Alberta list.

166. *Leucorrhinia hudsonica* (Selys.). Cranbrook Dist., May 17, 1915, (Coll.?). New to British Columbia list.

167. *Leucorrhinia intacta* Hagen. Saanich Dist., B.C., June 12, July 20, 1917; Elk Lake, Royal Oak, B.C., July 11, 1917, (W. Downes); Vernon Dist., July 6, 1916; Alberni, B.C., July 22, 1915, (W. R. C.). New to British Columbia list.

Collembola.

The following species of Collembola were collected at Arnprior, Ont., in 1917, by Mr. Charles Macnamara, who is making a special study of these insects.

Achorutes packardi Folsom.
Achorutes humi Folsom.
Xenylla maritima Tullberg.
Pseudachorutes complexus MacGillivray.
Neanura muscorum Templeton.
Podura aquatica Linn. (Red colour variety.)
Onychiurus ramosus Folsom.
Onychiurus fimetaria (Linn.) Lubbock.
Isotoma olivacea Tullberg.
Isotoma quadrioculata Tullberg.
Isotoma cinerea Nic.
Tomocerus bidentatus Folsom.
Tomocerus flavescens separatus Folsom.
Papirius pini Folsom.
Sminthurus hortensis Fitch.
Sminthurus hortensis juvenilis Fitch.
Sminthurus spinatus MacGillivray.

Araneida.

(Arranged according to Bank's Catalogue of Nearctic Spiders, U.S.N.M., Bull. 72. The numbers refer to the pages in the catalogue.)

Drassidæ.

* *Pœcilochroa columbiana* Em. Departure Bay, Van. Isl., B.C., 1913, (T. B. Kurata); Can. Ent., XLIX, 269.

9\. *Gnaphosa conspersa* Thor. Aweme, Man., (N. Criddle).

Agelenidæ.

15\. *Cicurina arcuata* Keys. Aweme, Man., (N. Criddle).

Theridiidæ.

20\. *Theridium zelotypum* Em. Truro, N.S., and West River, N.S., (R. Matheson).

* *Aræoncus patellatus* Em. Metlakatla, B.C., (J. H. Keen); Can. Ent., XLIX, 262.

Lophocarum sculptum Em. Metlakatla, B.C., (J. H. Keen); Can. Ent. XLIX, 261.

* *Gonglydium macrochelis* Em. Banff, Alta., (N. B. Sanson); Can. Ent., XLIX, 263.

Gonglydium curvitarsis Em. Sulphur Mt., Banff, Alta., on snow, April, 1917, (N. B. Sanson). Described from Mt. Whiteface, Adirondacks, N.Y.

Linyphiidæ.

* *Diplostyla brevipes* Em. Metlakatla, B.C., (J. H. Keen); Can. Ent., XLIX, 267.

* *Diplostyla keenii* Em. Metlakatla, B.C., (J. H. Keen); Can. Ent., XLIX, 267.

* *Microneta pallida* Em. Departure Bay, Vanc. Isl., B.C., 1913, (T. B. Kurata); Can. Ent., XLIX, 265.

* *Microneta orcina* Em. Inverness, B.C., (J. H. Keen); Can. Ent., XLIX, 266.

Epeiridæ.

39\. *Zilla atrica* Koch. Digby, N.S., and Truro, N.S., (R. Matheson).

41\. *Epeira cavatica* Keys. Hampton, N.B., and Hillsborough, N.B., (R. Matheson).

Thomisidæ.

* *Philodromus canadensis* Em. "Montreal, Ottawa, and westward to Lake Nipigon and Prince Albert"; Can. Ent., XLIX, 270.

Lycosidæ.

Lycosa wrightii Em. Aweme, Man., (N. Criddle).

60\. *Pardosa tachypoda* Thor. Arnprior, Ont., (C. Macnamara).

* *Pardosa metlakatla* Em. Metlakatla, B.C., (J. H. Keen); Mountains north of Vancouver, B.C., (G. W. Taylor); Can. Ent., XLIX, 268.

* *Pardosa vancouveri* Em. Departure Bay, Vanc., Isl., B.C., and Vancouver, B.C., (T. B. Kurata); Can. Ent., XLIX, 269.

Attidæ.

* *Chalcoscirtus carbonarius* Em. Simpson Summit, 7,000 feet, near Banff, Alta.; Can. Ent., XLIX, 271.

INDEX.

Ontario Department of Agriculture

Forty-Ninth Annual Report

OF THE

Entomological Society

OF ONTARIO

1918

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO

TORONTO:
Printed by A. T. WILGRESS, Printer to the King's Most Excellent Majesty
1919

Ontario Department of Agriculture

Forty-Ninth Annual Report

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TORONTO:

Printed by A. T. WILGRESS, Printer to the King's Most Excellent Majesty

1919

Printed by
THE RYERSON PRESS

To His Honour, SIR JOHN STRATHEARN HENDRIE, a Lieutenant-Colonel in the Militia of Canada, etc., etc., etc.,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned begs to present for the consideration of your Honour, the Report of the Entomological Society for 1918.

Respectfully submitted,

GEO. S. HENRY,
Minister of Agriculture.

Toronto, 1919.

CONTENTS

Entomological Society of Ontario

OFFICERS FOR 1918-1919

President—Prof. Lawson Caesar, Dept. of Entomology, Ontario Agricultural College, Guelph.

Vice-President—Mr. Arthur Gibson, Entomological Branch, Dept. of Agriculture, Ottawa.

Secretary-Treasurer—Mr. A. W. Baker, B.S.A., Lecturer in Entomology, O. A. College, Guelph.

Curator—Mr. Eric Hearle, *B.S.A., Guelph.*

Librarian—Rev. Prof. C. J. S. Bethune, M.A., D.C.L., F.R.S.C., Professor of Entomology and Zoology, O. A. College, Guelph.

Directors—Division No. 1, Mr. J. M. Swaine, Entomological Branch, Dept. of Agriculture, Ottawa; Division No. 2, Mr. C. E. Grant, Orillia; Division No. 3, Dr. A. Cosens, Toronto; Division No. 4, Mr. F. J. A. Morris, Peterborough; Division No. 5, Mr. J. W. Noble, Essex; Division No. 6, Mr. J. F. Hudson, Strathroy; Division No. 7, Mr. W. A. Ross, Vineland Station.

Directors (ex-Presidents of the Society)—Rev. Prof. C. J. S. Bethune, M.A., D.C.L., F.R.S.C., Guelph; Prof. John Dearness, Vice-Principal, Normal School, London; Rev. Thomas W. Fyles, D.C.L., F.L.S., Ottawa; Prof. Wm. Lochhead, B.A., M.S., Macdonald College, Que.; John D. Evans, C.E., Trenton; Prof. E. M. Walker, B.A., M.B., F.R.S.C., University of Toronto; C. Gordon Hewitt, D.Sc., F.R.S.C., Dominion Entomologist, Ottawa; Mr. Albert F. Winn, Westmount, Que.

Editor of "The Canadian Entomologist"—Prof. E. M. Walker, Toronto.

Delegate to the Royal Society of Canada—The President.

FINANCIAL STATEMENT

For year ending October 31st, 1918.

Receipts.		*Expenditures.*	
Cash on hand, 1916-17	$42 10	Expense	$52 00
Advertisements	15 25	Cork and Pins	51 60
Back Numbers	75 94	Printing	1,316 00
Cork and Pins	74 87	Annual Meeting	101 17
Dues	93 34	Annual Report	25 00
Subscriptions	443 60	Salaries	125 00
Bank Interest	8 95	Insurance	26 00
Government Grant	1,000 00	Cash on hand	57 28
	$1,754 05		$1,754 05

To balance due on printing	$102 59
By cash on hand	57 28
Net deficit	$45 31

Auditors: L. Caesar,
J. E. Howitt.

Respectfully submitted,

A. W. Baker,
Secretary-Treasurer

LIST OF MEMBERS

Ontario

Aitchison, James	Grimsby.
Andrews, H. D.	Toronto.
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Dunlop, James	Woodstock.
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Fouse, C. M.	"
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Gooderham, C. B.	"
Grant, C. E.	Orillia.
Grant, L. J. M.	"
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Hutchings, C. B.	Ottawa.
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Nash, C. W.	"
Noble, J. W.	Essex.
Petch, C. E.	Ottawa.
Reid, D. E.	Todmorden.
Ross, W. A.	Vineland.
Saxby, J. W.	Toronto.
Shorey, W. P.	Guelph.
Sladen, F. W. L.	Ottawa.
Smith, Arthur	Toronto.
Snazelle, C.	"
Spencer, Capt. G. J.	Guelph.
Strickland, E. H.	Ottawa.
Swaine, J. M.	"
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Tomlinson, A. H.	Guelph.
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Gilliat, F. C.	Annapolis Royal.
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Kelsall, A.	Annapolis Royal.
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Longley, Miss M.	Paradise.
Mackay, Dr. A. H.	Halifax.
McMahon, E. A.	Annapolis Royal.
Payne, H. G.	Annapolis Royal.
Payne, S. H.	Granville Ferry.
Perrin, Joseph	Halifax
Perry, Prof. H. G.	Wolfville.
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Saunders, L. G.	Truro.
Spittal, J. P.	"
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Whitehead, W. E.	Truro.
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Brown, W. A. .... "
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Phair, A. W. A. .... Lillooet.
Robson, A. C. U. .... Victoria.
Ruhman, M. .... Vernon.
Sherman, R. S. .... Vancouver.
Taylor, L. E. .... Kelowna.
Treherne, R. C. .... Agassiz.
Venables, E. P. .... Vernon.
Ward, W. C. .... Vancouver.
White, E. W. .... Victoria.
Winson, J. W. ...... Huntingdon.

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Howard, Dr. L. O. .... Washington, D.C.
Wickham, Prof. H. F..... Iowa City, Ia.

LIFE MEMBERS

Bethune, Rev. C. J. S., Professor of Entomology, Ontario Agricultural College .... Guelph.
Evans, John D., C.E. .... Trenton.
Fyles, Rev. Dr. T. W. .... Ottawa.

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*King, V. .... Bureau of Entomology, Washington, D.C.
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McCubbing, C. .... . Salmon Arm, B.C.
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Snazelle, Chas. ....Thornloe, New Ontario.
Spencer, Capt. G. J. ...O.A.C., Guelph.
Strickland, E. H. .... Entomological Br., Ottawa.
Venables, E. P. ....Vernon, B.C.
*Walsh, Lieut. F. W. . O.A.C., Guelph.
Williams, C. M. ....Nappan, N.S.
Wilson, Ed. .... Vancouver, B.C.
Wright, Lieut. W. H. ..O.A.C., Guelph.

* Killed in action.

Entomological Society of Ontario

ANNUAL MEETING

The Fifty-fifth Annual Meeting of the Entomological Society of Ontario was held at the Ontario Agricultural College, Guelph, on Wednesday and Thursday, December 4th and 5th, 1918. The chair was taken by Prof. Lawson Caesar, the President. The following were present at the meeting: Mr. J. J. Davis, West Lafayette, Ind.; Prof. P. J. Parrott, Geneva, N.Y.; Prof. R. Matheson, Ithaca, N.Y.; Dr. C. Gordon Hewitt; Messrs. Arthur Gibson, C. E. Petch, C. B. Hutchings, F. W. L. Sladen and Dr. S. Hadwen, Ottawa; Prof. E. M. Walker and Dr. W. A. Clemens, Toronto; Mr. James Dunlop, Woodstock; Mr. W. A. Ross, Vineland; Mr. W. E. Biggar, Hamilton; Mr. F. J. A. Morris, Peterborough; Mr. H. F. Hudson, Strathroy; Father Leopold, La Trappe, Que.; Prof. W. Lochhead, Macdonald College, Que.; Mr. F. Letourneau, Oka, Que.; Prof. W. H. Brittain, Truro, N.S.; Mr. John D. Tothill, Fredericton, N.B.; Mr. Norman Criddle, Treesbank, Man.; Professors C. J. S. Bethune, L. Caesar, J. E. Howitt and D. H. Jones; Dr. R. E. Stone; Messrs. A. W. Baker, H. G. Crawford, Eric Hearle, R. M. Aiton, H. C. Huckett and others, Ontario Agricultural College.

By the kindness of Dr. Creelman the visitors were entertained in the College Residence during their stay in Guelph. This arrangement added much to their pleasure by affording many opportunities for social converse, and also saved the time usually spent in travelling to and from the town.

During the morning of Wednesday, Dec. 4th, a meeting of the Council was held, at which various matters of business were brought up and discussed. It was decided that the next place of meeting be Ottawa, the date to be fixed later. A suggestion was made and afterwards adopted at the general meeting, that the *Canadian Entomologist* be issued in ten instead of twelve numbers, but that the quantity of matter remain as heretofore; and also that the size of the page be increased to conform with the majority of scientific publications.

In the afternoon the Society met at 1.30 o'clock. After opening the meeting the President read a letter from Mr. Wolley Dod, from Mesopotamia, which was much appreciated. The following message, proposed by Messrs. Gibson and Tothill, was sent to Dr. Fyles:—

"Entomologists from Canada and the United States now in session at Guelph, extend to you their warmest greetings and regret your inability to attend."

The Reports of the Council, Treasurer, Librarian and Curator were then read and adopted. The Reports of the various Branches, the delegate to the Royal Society of Canada, and the Directors were taken as read.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1917-1918.

The Fifty-fourth Annual Meeting of the Society was held at Macdonald College, P.Q., on Thursday and Friday, November 8th and 9th. The President

of the Society, Mr. A. F. Winn, Westmount, P.Q., occupied the chair. There was a very satisfactory attendance of members and visitors; among the latter were Messrs. A. F. Burgess, Melrose Highlands, Mass., and J. H. Emerton, Boston; Drs. T. J. Headlee, New Brunswick, N.J., and W. C. O'Kane, Durham, N.H. A large number of papers of interest and importance were read and discussed, of which the following is a list. Reports on Insects of the year in the various Divisions of the Province by the Directors, Messrs. Gibson, Cosens, Morris, Noble and Ross; "Further Notes on the Imported Onion Maggot and its Control," by Mr. Arthur Gibson; "The Entomological Service of Quebec," by Mr. Georges Maheux; "Some Important Insects of the Season," by Prof. Caesar; "The Apple and Thorn Skeletonizer," by Dr. E. P. Felt; "Some Notodontian Larvæ," by Dr. J. A. Corcoran; "The Problem of Mosquito Control," by Dr. T. J. Headlee; "The Black Cherry Aphis," by Mr. W. A. Ross; "A Comedy of Errors," by Mr. F. J. A. Morris; "Transcanadian Spiders," by Mr. J. H. Emerton; "A Further Report on the Value of Dusting vs. Spraying," by Prof. L. Caesar; "Notes on the Ecology of Insects," by Prof. W. Lochhead; "Effects of Stable and Horn-fly Attacks on Milk Production," by Mr. A. W. Baker; "Two Unusual Garden Pests in Nova Scotia," by Prof. W. H. Brittain; "The Entomological Record," by Mr. Arthur Gibson. These papers have been published in the Forty-eighth Annual Report of the Society which was issued by the Ontario Department of Agriculture in October last. The following papers were also read but not submitted for publication: "Black Flies in the Dixville Notch," by Dr. W. C. O'Kane; "The Nervous System of Caterpillars and its Relation to Classification," by Mr. J. M. Swaine; "Habits, Behaviour and Tropisms of Insects," by Dr. Arthur Willey. By the courtesy of the U. S. Bureau of Entomology, were exhibited motion pictures of "Field and Parasite Work Against the Gypsy and Brown-tail Moths," through Mr. A. F. Burgess and Dr. C. Gordon Hewitt, and of "Orchard Spraying in Nova Scotia," by Prof. W. H. Brittain. A symposium was held at the close of the evening session on the question of how Canadian Entomologists can help to increase food production, led by Dr. Hewitt and participated in by many of the members.

The Canadian Entomologist, the official organ of the Society, has been regularly issued each month. The fiftieth annual volume will be completed by the issue of the forthcoming December number. The forty-ninth volume, published during 1917 contained 440 pages, illustrated by 21 full page plates and 41 figures in the text. The contributors to its pages numbered 64 and included writers in Ontario, Quebec, Nova Scotia, Manitoba, Alberta and British Columbia, and also in eighteen of the United States. The series of papers on "Popular and Practical Entomology" was continued each month and provided interesting and instructive information for the general reader. In the systematic papers there were described four new genera, 137 new species and 10 new sub-species or varieties. As a result of the publication from year to year of a large number of articles on descriptive and systematic entomology, there is a constant demand for back numbers and volumes.

Twenty-five new members have been added to the rolls of the Society.

It is with deep regret that the Council records the removal by death of one of our oldest and most distinguished members, Mr. William Hague Harrington, who died at his home in Ottawa on the 13th of last March in the 66th year of his age. He was well-known to Entomologists throughout North America by his systematic work in the order Hymenoptera, and was justly regarded as our best

Canadian authority on this department of the insect world. Of late years he had taken up the study of Botany with characteristic energy, and became familiar with the Flora as well as the Fauna of Ottawa and the surrounding country. An appreciative memoir by Mr. Arthur Gibson and an excellent portrait appeared in the June number of the *Canadian Entomologist.*

To the Society's Roll of Honour in the world-wide war, have now to be added the names of Captain R. V. Harvey and Lieut. Vernon King, who have laid down their lives on the battlefield in defence of the Empire and the freedom of mankind. Captain Harvey was for nine years Secretary of the British Columbia Branch of our Society (1902 to 1911) and the success of the Branch during that period was almost entirely due to his enthusiastic work. In the collection and study of insects he devoted himself at first to the Lepidoptera and of late years to the Diptera. At the outbreak of the war he joined the 7th Battalion and was with the first Canadian forces who went to France. In April, 1915, he was severely wounded in a charge and died a few weeks later in a German prison camp. Lieut. King, an Englishman by birth and a graduate of the Ontario Agricultural College, was employed in the Cereal and Forage investigation branch of the U. S. Bureau of Entomology, where he was doing excellent work. He could not, however, resist the call of patriotism and in November, 1914, he returned to Canada and entered the British Army. He served in Egypt and the Dardanelles, and subsequently joined the Flying Corps in France. During an air fight against heavy odds he lost his life on April 11th, 1918.

REPORT OF THE LIBRARIAN.

Owing to the want of funds available for the purpose, the only books purchased for the Library during the year ending October 31st, 1918, are Fabre's "The Life and Love of the Insect," Burmeister's "Manual of Entomology," and Comstock's "The Wings of Insects." Including these works, fourteen bound volumes have been placed upon the shelves, making the total number 2,285. There is a large accumulation of unbound periodicals, bulletins, reports and pamphlets, which, it is to be hoped, may some day be bound and made more readily available for reference.

Respectfully submitted,

CHARLES J. S. BETHUNE, *Librarian.*

REPORT OF THE CURATOR.

The Society's collections have been examined from time to time, and the necessary steps taken to prevent injury from museum pests or other causes. At the present time they are in good condition.

Respectfully submitted,

ERIC HEARLE.

REPORT OF THE MONTREAL BRANCH.

The 376th regular and 45th Annual Meeting of the Montreal Branch was held at the residence of the President, Mr. A. F. Winn, 32 Springfield Ave., Westmount, on Saturday evening, May 11th, 1918.

The report of the Council showed that during the season seven meetings were held with a total attendance of 85, or an average of over 12 per meeting. A public meeting was held in March at the Redpath Museum, McGill University, when Mr. J. M. Swaine came from Ottawa and gave an illustrated lecture on "The Protection of Shade Trees in Cities." At this time the Lyman Entomological Collection was opened for inspection.

During the season the following papers and talks were given before our Society:—

1. President's Annual Address ....A. F. Winn.
2. An account of insects in vegetable plots ....Dr. Corcoran.
3. Tussock moths ....Dr. F. S. Jackson.
4. A trip to the Provincial Forest Nursery, Berthierville, Q....A. F. Winn.
5. A few moths from Bondville, Q., 1917 ....A. F. Winn.
6. Notes on bees ....G. H. Hall.
7. Report of annual meeting of Ent. Soc. of Am. at Pittsburg, Pa. ....Dr. Corcoran.
8. Notes on the Geometrid species of Genus, Acidalia, Guenesia, Cabera ....G. Chagnon.
9. Hemiptera found in a backyard garden, 1917 ....Geo. A. Moore.
10. Description of Entomological work in England, 1917 ....Lachlan Gibb.
11. Chilo comptulatalis Hulst ....A. F. Winn.
12. The protection of shade trees in cities ....J. M. Swaine.
13. E. P. Van Duzee's catalogue of Hemiptera of America ...... Geo. A. Moore.
14. Collecting in England, 1917 ....Lachlan Gibb.
15. The Daylight Saving Act, what it will do for Entomologists..A. F. Winn.
16. Directions for collecting and preserving Orthoptera for the cabinet ....G. Chagnon.

The Treasurer's Report showed a balance of $150.93.

The following were elected as officers for the coming year:—

President ....A. F. Winn.
Vice-President ....G. Chagnon.
Secretary-Treasurer ....Geo. A. Moore.
Librarian ....G. Chagnon.
Council ....G. A. Souther, Dr. Corcoran, J. G. Holmes, G. H. Hall.

Respectfully submitted,

Geo. A. Moore, *Secretary*.

REPORT OF THE TORONTO BRANCH.

The 217th meeting and 22nd Annual Meeting of the Toronto Branch of the Entomological Society of Ontario, was held in the Biological Building of the University of Toronto, Nov. 21st, 1918, the President, Dr. Clemens, in the chair. The minutes of the previous meeting were read and approved. The report of the Council, the financial statement, and the report of the Librarian were presented and adopted.

The report of the Council showed that during the season of 1917-1918, six regular meetings, one special meeting, and the Annual Meeting were held in

the Biological Building of the University of Toronto. The average attendance at the regular meetings, including visitors, was 15 persons. During the season the following papers were read before the Society:—

1917.		
Nov. 22.	Life of Spring Ponds	Dr. E. M. Walker.
Dec. 13.	War Services of Entomologists	Dr. W. A. Clemens.
	Summer Work of New York State Food Commission	John Detweiler.
1918.		
Jan. 24.	The 1917 Collecting Season	Mr. H. V. Andrews.
Feb. 15.	Fruit Flies	Prof. L. Caesar, Guelph.
Mar. 21.	Fossil Insects	Dr. A. Cosens.
Apr. 4.	Injurious Shade Tree Insects and their Control	Mr. J. M. Swaine, Ottawa.
May 9.	Personal Experiences with Tropical Insects	Mr. F. J. Harris.

Seven new members were elected during the year: Messrs. D. E. Reid, B. Wright, Frank Foulds, John Detweiler, R. W. Blakely, F. J. Harris, F. Broderick.

We regret to record the death of two esteemed members, Mr. Samuel T. Wood and Miss Dorothy Fraser. Mr. Wood was well known among nature lovers throughout Canada by his charming writings, particularly the weekly editorials in the *Globe*, on various phases of wild life, and his loss is keenly felt by a large circle of friends, to whom he had endeared himself by his kindly, unassuming personality.

Miss Fraser who was on the staff of the Biological Department of the University of Toronto, graduated from this department in 1917 with the highest honours in Biology. She won the esteem and admiration of all her colleagues by her fine character, her unfailing industry in spite of delicate health, and her unusually keen scientific judgment.

At the meeting of December 13th, 1917, steps were taken toward the formation of a special committee for the purpose of organizing a campaign against the Tussock Moth in Toronto. This committee met five times between January and May. The following programme was drawn up and carried out:—

1. Stirring articles were written by several members of the Society and published in the daily papers. These articles dealt briefly with the destructiveness of the Tussock Moth caterpillars, methods of control, and the responsibility of the citizens in helping to combat the pest.

2. On April 4th a special joint meeting of the Toronto Branch, the City Parks Department, and the Toronto Horticultural Society, was held in the large lecture hall of the Biological Building of the University of Toronto, at which Mr. J. M. Swaine gave a very able and interesting address on "Shade Tree Insects," dealing particularly with the Tussock Moth.

3. An attractive illustrated pamphlet was prepared, and 5,000 copies were printed and distributed to the schools of the city.

4. Through the courtesy of the City Parks Department, four sets of lantern slides were prepared, bearing the same illustrations as the pamphlets, and giving short concise directions for controlling the pest. These were circulated among various motion picture theatres in the city.

Special donations amounting to $35.00 were contributed by the following gentlemen: Major R. J. Christie, Mr. James O'Brien and Mr. Paul Hahn.

The results from the campaign were very gratifying.

The financial statement showed a balance on hand of $19.97.

The report of the librarian shows that a large number of pamphlets and periodicals have been added to the library during the season of 1917-18.

Special arrangements have been made with the Department of Biology, University of Toronto, in regard to filing and shelving space, and by which members of the Department may have access to the literature. Good progress has been made in re-arranging and cataloguing.

The publications received since the last meeting were presented.

The election of officers was then proceeded with, and the results were as follows:

President ....Dr. W. A. Clemens.
Vice-President ....Mr. H. V. Andrews.
Secretary-Treasurer ....S. Logier.
Librarian ....Miss Norma Ford.
Council ....Dr. E. M. Walker, Dr. A. Cosens, Messrs. T. B. Kurata, J. Hannibal, C. K. Brobst.

The business of the evening finished, the meeting was then left open for short talks by members and for discussion. The following members spoke:

C. K. Brobst on the Tussock Moth work in Toronto in summer of 1918.

Dr. A. Cosens, on "Observations on the Monarch Butterfly."

Mr. H. V. Andrews, on "A trip to Go Home Bay for Oeneis chryxus, var. calais."

Dr. E. M. Walker on "Oeneis chryxus, var. calais."

Mr. S. Logier, on "Observations on parasitized caterpillars."

Those present at the meeting were: President Dr. W. A. Clemens, Dr. Cosens, Dr. Walker, Miss N. Ford, Messrs. Kurata, Andrews, Harris, Reid, Wright, Hannibal, Blakely, Broderick, Brobst, Logier, and five visitors, in all, 19 persons.

Respectfully submitted,

Shelley Logier, *Sec.-Treas.*

REPORT OF THE BRITISH COLUMBIA BRANCH.

The 17th Annual Meeting of the British Columbia Branch was held in the City of Victoria, B.C., Saturday, February 23rd, 1918. The morning session was called to order by President E. H. Blackmore. Secretary William Hugh handed in his financial statement and read a report of the Society's work during the past year.

The following papers were read and discussed:—

President's Address ....E. H. Blackmore.
Notes on the Classification and Bionomics of the Hemiptera ....Wm. Downes.
Collecting in the Lillooet District—A trip to Mount McLean ..A. W. Phair.
Life History of *Perigrapha praeses* Grt..........................Geo. O. Day.
On Parthenogenesis in the Honey Bee ....William Hugh.
Insect Notes ofthe Year ....R. C. Treherne.

Afternoon Session.

Notes on the Mycetophilidae of B. C.:
A Revision of the B. C. species of the genus Hydriomena based on the character of the male genitalia ....E. H. Blackmore.
Notes on the Aeolothripidae ....R. C. Treherne.
Natural Control Investigations in B. C.:
Life History of the Leaf-Eating Crane Fly, Cylindrotoma spendens, Doane (Diptera, Tipulidae) ....Dr. A. E. Cameron.

The following were elected to the several offices for the year 1918:—

Hon. President ....F. KERMODE, Provincial Museum.
President ....R. S. SHERMAN, Vancouver, B.C.
Vice-President (Interior) ....J. W. COCKLE, Kaslo, B.C.
Vice-President (Coast) ....WM. DOWNES, Victoria, B.C.
Hon. Secretary-Treasurer ....WILLIAM HUGH, Box 20, Cloverdale, B.C.
Advisory Board ....MESSRS. E. H. BLACKMORE, R. C. TREHERNE, G. O. DAY, A. W. HANNAM, L. A. BREUN.

The Society offered the Vancouver Exhibition Association two prizes for the best collection of types of beneficial and injurious insects put up by school children.

REPORT OF THE NOVA SCOTIA BRANCH.

Since our last report was presented to our parent Society a new number of our "Proceedings" has been issued, comprising approximately 100 pages and including considerable new data on Nova Scotian insects and the problems connected with their control. Another Annual Meeting was held on July 26th of the present year, when a number of papers were read by the members and a successful session was held. The speaker of the occasion was Mr. J. D. Tothill, of the Dominion Entomological Branch, who gave a paper on "The Meaning of Natural Control." The following officers for the year were elected:—

Honorary President ....DR. A. H. MCKAY, Halifax.
President ....L. A. DEWOLFE, Truro.
Secretary-Treasurer ....W. H. BRITTAIN, Truro.
Asst. Secretary-Treasurer ....E. C. ALLEN, Truro.
Committee ....A. KELSALL, Annapolis Royal, and MISS AILEEN HENDERSON, Lawrencetown.

Like all other organizations our Society has suffered many inroads in its membership on account of the war. In spite of this we have been able to keep up our members to the pre-war level and are particularly fortunate in the fact that none of our members who have gone overseas have actually lost their lives in the great struggle. With the return of peace time conditions and the removal of all hindrances to our expansion, we are hopeful of healthy, vigorous growth from now on.

W. H. BRITTAIN, *Secretary*.

REPORTS ON INSECTS FOR THE YEAR.

DIVISION NO. 3, TORONTO DISTRICT—A. COSENS.

The unusual abundance of the Monarch, *Anosia plexippus*, during the past two years, led me to hope that this season I could obtain a series of notes that would be of interest concerning this wide-ranging Canadian butterfly.

In looking over these notes, however, I find only a few of sufficient importance to include in this report. This was owing chiefly to the butterflies not being sufficiently numerous to prevent an ebbtide in the enthusiasm of the early part of the season.

Concerning the first to arrive of the migrants from the south I have made the following note:—

June 15th. "Two specimens of Anosia were seen flitting about a few milk-weed plants on the Old Belt Line, near the Humber; one of the butterflies appeared to be ovipositing, but the eggs could not be found."

The above apparently represents, in general, the date of the first appearance in Ontario of this butterfly, since it agrees with that noted by other observers. In 1900, Mr. C. W. Nash, Toronto, states that he saw the Monarch first on June 14th, and in 1901, Mr. J. A. Moffat, London, noted its arrival there on June 12th.

While the middle of June may be taken as the average date of their arrival in this Province, there must be at least isolated butterflies that return much earlier.

With reference to this I find in my notes:—

June 19th. "Mr. Martin saw, on milkweed plants, a nearly full-grown Monarch larva, also a much smaller one."

Later in the day we found the larger larva but did not get the smaller. The one we captured was one and three-fourths inches in length. The egg from

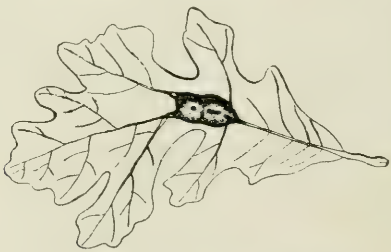

Fig. 1.—Gall produced by *Neuroterus flavipes* Gill on Bur Oak, *Quercus macrocarpa* Michx.

which this larva emerged must have been deposited the end of May or very early in June.

There are notes under two other dates in June.

June 24th. "Anosia butterflies plentiful around the milkweeds at Mimico Creek."

June 27th. "In the same locality as the preceding, caught three males and two female butterflies. These specimens were all much faded and worn, the wing margins were also badly torn. The butterflies were frequently mating at this time."

Nothing of interest appears to have been observed for a month, as the next note reads:—

July 27. "Many Monarch butterflies ovipositing, all the specimens captured were faded and torn. Larvæ were frequently seen, these varied from one-half to full-grown; ten of the latter were collected."

July 30th. "Several of the larvæ taken on the 27th have pupated."

With very little further feeding these larvæ eventually all passed into the chrysalid stage, and all emerged, sometime between the 9th and the 22nd of August, the exact date unknown owing to absence from the city.

Although these butterflies, during the last two seasons, gave ample opportunity, in this locality, of observing their congregating habits, I was not fortunate enough this fall to see a single flock.

I wish also to report the securing of the producers from a gall on Bur Oak, *Quercus macrocarpa*. These producers have been kindly identified by Mr. Wm. Beutenmuller as *Neuroterus flavipes* Gill.

The gall, which is polythalamous, is an elongated, irregular swelling from the midrib of the leaf, but also extending out slightly along the veins. It is somewhat triangular in cross section. Opening on the upper surface of the leaf, from which the gall chiefly projects, are minute canals, one passing to each larval chamber.

Length of gall parallel to the axis of the midrib 10-15 mm.

In all probability a revision of the Cynipidae will place this species in the genus Andricus, as it closely resembles *A. piger* Bassett and *A. petiolicola* Bassett. The former is a polythalamous gall produced by the swelling of the petiole or midrib of the Scarlet Oak, *Quercus coccinea*. The latter is also located on the petiole or midrib of the leaf, but the host in this case is the White Oak, *Quercus alba*. It is an irregular, spherical swelling drawn out at some place on its surface into a short tapering projection. At the summit of this is an opening surrounded by a dense ring of coarse, brown trichomes.

Division No. 5, Peterborough District—F. Morris, Peterborough.

My report for the present year again deals chiefly with *Cerambycidae*. The first series of observations made relate to the obscure little *Anaglyptus*, Le Conte's *Microclytus* (or rather *Cyrtophorus*) *gibbulus*. This insect had been taken in considerable numbers in 1916 and 1917, feeding on choke-cherry blossom, dogwood and spiked maple, during the first three weeks of June. In the former season the blossom was well out by June 3rd, in the latter by June 10th. This season I made my way out to the place of capture about the middle of May, and found the corner of the wood where the insect had been prevalent already in the act of falling beneath the woodman's axe! It was too early for the blossom and there was no trace of the insect. Before paying the spot another visit, I decided to wait till the end of May. Soon after this decision, however, a hot spell brought the blossoms on with a rush, and I was dismayed on passing a woodyard in the city one day to see a shrub of choke-cherry in full bloom; next day (May 23rd) I hurried out to the "Wood of Desire" and found the shrubs actually shedding their bloom. I had missed the height of the insect's season. The air that day was cold, and I found only a single specimen. It was the more disappointing that I had arranged to go north over the week-end. However, on Tuesday, May 27th, I was back at the hunting ground and had the good fortune to find two or three trees of choke-cherry in a somewhat less exposed position on the margin of the wood; here I secured more than 20 of the insect, including five natural pairs secured from specimens taken home alive and mating in captivity. June proved a very poor blossoming season in our district, and almost no captures were made on dogwood, viburnum and spiked maple. Beyond a single specimen of *M. gibbulus* taken on dogwood on June 1st, I saw no further trace of this elusive little insect. In each of the last three years when it has been captured, the season of its prevalence has been limited to a fortnight and is practically dependent on the blossoming of the choke-cherry clusters; viz., 1916, June 4-18; 1917, June 9-24; 1918, May 20-June 1.

On May 24th, while at Lake Catchacoma, some 30 miles north of Peterborough, I found an extraordinary number and variety of insects drawn in the hot sun to the choke-cherry clusters; besides about 10 species of Longicorn, there were a large number of species of Chrysomelians, Scarabs and Elaters; among these last, three species of *Corymbites* including *C. hamatus* and *C. vernalis;* but the most interesting by far to me of the day's bag was a pair of the very handsome Cantharid, *Pomphopoea aenea.* Only once before had I ever seen this insect, and that was at Port Sydney towards the end of June, when I found a pair on the Nannyberry (*Viburnum lentago*). It is a large insect of a beautiful grey-blue-green shade and of satiny texture; the antennae black, and the legs orange-yellow with black knees and feet. Of the species I am not quite sure; Dr. Bethune who kindly identified the earlier capture thought it *P. sayi*, but according to Blatchley the yellow and black legs belong to *P. aenea*. This had been 1909, for it was just a few weeks before Dr. Brodie's death, with whom I was staying in North Muskoka at the time.

On the first of June I captured two specimens of the so-called Currant-borer (*Psenocerus supernotatus*) settling on a newly fallen poplar stem. On June 10th while ranging about a tamarac swamp for Pyrola and Cypripedium, I had the good fortune to capture a breeding pair of *Tetropium cinnamopterum* resting in the shadow on the underside of a recent windfall of white spruce, the only tree I have ever captured this insect on. On June 15th—rather an early record—while foraging about at the "Wood of Desire," I spied a specimen of *Desmocerus palliatus*, flying from a small clump of the late elder; examination of the shrubs led to the capture of a dozen of these handsome borers; they had evidently just emerged and were crawling up into the sunlight from the stems, a few were already pairing and taken at rest on the underside of the foliage. A specimen of *Goes oculatus* was taken the same day on newly fallen poplar. On June 18th, while exploring a very rich corner of tamarac swamp, I made two finds especially that awoke happy memories: after an interval of 19 years, I found again that local rarity among the orchids, *Orchis rotundifolia*, and on the swamp Valerian—just as three years before near Trenton—I found *Leptura chrysocoma* feeding on pollen. Between June 18th and 20th, I took three specimens of this beetle always among tamaracs. On June 25th, I captured a specimen of *Saperda tridentata* on an elm log, and on a large billet of poplar in a woodpile, a pair of *Pogonochaerus mixtus.*

On June 29th and 30th, during a short stay in Port Hope, I paid a visit to some woods four miles north where a season or two before the woodman's axe had been very busy—far too busy, for every windstorm since has taken heavy toll of the surviving timber. The work of tramping in hot sunshine through bush, and stumbling or slipping on hidden logs and stumps was very exhausting, but a number of interesting captures were made. Among these, one *Leptura zebra* on the sheaf of foliage about an oak stump, five *Neoclytus erythrocephalus* taken running on the trunk and limbs or two fallen trees, a basswood and a butternut, one *Clytus marginicollis* on white pine, three *Physocnemum brevilineum* on fallen elm, three *Leptostylus sex-guttatus* in brush-heaps of white pine, one *Leptostylus macula* on basswood, one *Goes oculatus* and one *Urographis fasciatus*, both resting on the underside of a lodged trunk of maple, three *Hoplosia nubila* on basswood, two *Lepturges symmetricus* and one *Eupogonius subarmatus* on a recent windfall of basswood.

On July 4th a trip from Peterborough to the "Wood of Desire" proved very

successful: among other captures, two *Liopus variegatus* on fallen poplar, one *Lepturges querci* on sumac, one *Xylotrechus undulatus* on spruce, two *Desmocerus palliatus* from the same little clump of late elder as had yielded several captures nearly three weeks earlier, two *Oberea tripunctata* and one very small and faintly marked specimen of *Clytanthus ruricola* on raspberry foliage. Next day, on a dead branch of sumac I took a specimen of *Neoclytus erythrocephalus*. On July 6th I took a specimen of *Hoplosia nubila* near Chemong from the same dead limb of basswood as yielded over a score last season. On July 8th, three *Liopus alpha* from dead or dying sumac branches. On July 11th in the heart of a large tamarac swamp on various blossoms including yarrow, daisies and fleabane (feeding on pollen in the hottest of sunshine) 19 *Leptura chrysocoma*, and on the edge of the swamp in milkweed blossom, three *Typocerus velutinus* and two *T. zebratus;* I strongly suspect *L. chrysocoma* to bore in the tamarac, for I have never found it far from that tree. On July 17th, I took fifteen *T. zebratus* on blossom of sumac and milkweed, and one *Leptostylus macula* on a dying branch of sumac.

On July 18th, while with a brother botanist on a corduroy road in a tamarac swamp north of Bethany, I noticed a strange butterfly that at first I took for a fritillary or silver-spot; on capture it proved to be the very beautiful "Baltimore," *Melitaea phaëton*. Investigation in September showed a plentiful growth at the roadside of *Chelone glabra* or Turtlehead, the food plant of this insect's larva.

On July 20th, I paid a farewell visit to the "Wood of Desire" before going north to camp in the Algonquin Park. The day was spent following in the wake of the axe; here were taken, running on white pine logs that lay scorching in the sun, three *Neoclytus muricatulus* (including a mating pair); one *Urographis fasciatus* resting on foliage of a basswood stump; *Lepturges pictus* on a dying branch of basswood; these were all in the open or on the edge of the wood; in the depths among a confusion of felled hemlock, spruce and balsam, I took two *Leptura subhamata* and three *Xylotrechus undulatus* all on spruce.

The active collecting for the season came to an end between July 27th and August 3rd in the Park with the capture of some *Leptura canadensis* and four specimens of *Leptura biforis*, taken in flight about our little camp clearing on Big Island in Cache Lake.

Division No. 6, Essex District—J. W. Noble, Department of Agriculture, Essex, Ont.

Attacking Field Crops. Wireworms, white grubs, cutworms, grasshoppers, crickets. Considerable damage was done in the spring by white grubs to strawberry beds, wireworms to potatoes, cutworms to cabbage and tobacco plants, especially to the latter; a considerable acreage of tobacco had to be replanted on account of the ravages of the cutworm. In July owing to the very hot weather we had more trouble with grasshoppers and crickets than has been experienced in this county for some years. Grasshoppers stripped considerable vegetation but largely confined their energy to cutting binder twine after the sheaves had been tied. Many reports have been received in some instances where crickets and grasshoppers had destroyed binder twine in wholesale quantities. Clover seed midge was reported from a number of fields, but is not believed to be common throughout the county. Hessian fly: some reports of injury during fall of 1918.

Attacking Fruit Trees. Codling Moth very plentiful especially in uncared for orchards; considerable damage done in orchards that had not been sprayed, about three broods reported in many instances.

Plum Curculio very plentiful in plum orchards this season, considerable damage to apples.

San José Scale appears to be considerably winter killed during severe winter of January, 1918, still quite plentiful in uncared for orchards.

Tent caterpillar not common, few nests seen. Fall webworms rather plentiful.

Aphids. Considerable damage to tree fruits, very effectively controlled by tobacco decoction.

Peach tree borer very plentiful especially on trees which winter killed last winter.

Apple Maggot noticeably plentiful in one orchard, very little damage on the whole.

Fruits and Vegetables. Melon aphid and cucumber aphid again this season accounted for a great loss among the cucumber and melon growers but after the experience of last year a great many fields were saved by early spraying, tobacco decoction being the most popular remedy.

Onion thrips very plentiful in the Pelee marsh, no remedy as yet found satisfactory.

Onion root maggot again very plentiful, considerable acreage lost.

Asparagus beetles plentiful but as the acreage is limited very little reported.

Capsids were considered by Dr. Bethune to have been the cause of white spots appearing on the early tomato crop. Upon careful examination no insects were found and no cause could be located. It occurred in two fields and accounted for considerable loss.

Squash bugs and cucumber beetles. Considerable loss to the pickle growers resulted from these insects. Trapping was tried but with little success, application of a repellant seemed to have only partial results.

Greenhouse Insects. Greenhouse men experienced considerable trouble during the winter of 1917-18 with greenhouse white fly and with aphids. Nematodes were also plentiful. The best growers, however, practised soil sterilization and occasionally fumigated with hydrocyanic gas.

The President: I shall now ask Father Leopold to read his paper on "Economic Entomology in Quebec."

Father Leopold: Mr. President, I was so anxious to secure further information on spraying that I did not prepare a paper but a series of questions which I hope you and other entomologists who have been studying spray mixtures will answer. I believe this will be of more value than my paper would have been. My questions are:—

1. What spray mixtures should I recommend to our people next year for apple orchards?

2. Is it true that Bordeaux mixture causes very great injury by russeting the fruit? If so, which application causes most of the russeting?

3. What recommendations should be made in regard to dusting?

The President: As neither Mr. Sanders nor Prof. Brittain are here from Nova Scotia I shall ask Dr. Hewitt to tell us something about Mr. Sanders' results and what he intends to recommend this year in Nova Scotia.

Dr. Hewitt: I cannot, of course, respond to your request with as much satisfaction to those who are interested in this subject as Mr. Sanders would have been able to give had he been here.

Owing to what appears to be an injurious effect of lime sulphur in reducing the crop of apples in Nova Scotia, Mr. Sanders turned his attention to Bordeaux mixture which had been almost entirely given up in favor of lime sulphur as the fungicide in apple spraying. While it is, of course, not our function to investigate fungicides we were compelled to study them as carriers of insecticides. In Nova Scotia there is not the same demand for a scale destroying spray such as lime sulphur as in Ontario owing to the absence of San José Scale, the existence of which insect was chiefly responsible for the adoption of lime sulphur in other parts of the country.

Coupled with the scalicide properties of lime sulphur was its easy preparation and the powerful advocacy of the manufacturers. We found that when Bordeaux was substituted for lime sulphur in certain of the sprays we obtained better results both from the point of view of production and condition of the foliage; we also found that the trouble of russeting could be obviated by not using Bordeaux in the third spray, that is, the spray when the blossom petals have fallen which is apparently the period when the setting fruit is most susceptible to the Bordeaux injury.

In view of the excellent results that we obtained in our experimental plots and that have been obtained by some of the more prominent fruit growers in Nova Scotia, we are recommending the use of Bordeaux mixture instead of lime sulphur in the first, second and fourth sprays. In the third spray we find that sodium polysulphide has given us the best results. As an insecticide we are recommending in each spray the use of arsenate of lime.

We have felt that far too little is known with regard to the chemistry and bio-chemistry of spraying. Spray mixtures have often been recommended without a careful study of their chemical constitution or of their effect on foliage, fruit or insects. Accordingly, we are now making a very careful study of the chemical nature of the different compounds that result from mixing various insecticides with fungicides and of the effect of such compounds on the trees and on the insects that they are expected to destroy. By these means we hope to secure exact data that will enable us to experiment to better advantage and to secure results of real value.

But after all, I feel that the ultimate test will be made by the fruit grower who will be the best judge as to the sprays giving the best results, and after having carried out our investigations to the best of our ability we shall have to be content to leave the matter in the hands of the grower. If we can demonstrate to him the superiority of one spray over another he is generally willing to be convinced and to act according to our advice. Further, it is a mistake to assume that a spray combination that is the best in one fruit growing section of the country will be the best in another. Spraying systems must be worked out to suit the various localities. The day of the universal spray calendar has long passed and for this reason we are endeavoring to study our spraying problems locally.

Prof. Caesar: I shall briefly answer Father Leopold's questions and then ask Prof. Parrott to give us the benefit of his experiments in New York State.

I myself intend to recommend as usual lime-sulphur for the first spray, that is the one given either before or as the buds are bursting or just after they have burst. For the second spray, the one just before the blossoms burst, I shall recommend either lime-sulphur, 1 gallon to 35 gallons of water, or Bordeaux mixture, 4.4.40, and to each of these either arsenate of lead or arsenate of lime. For

the third application, the one just after the blossoms have fallen, I shall recommend lime-sulphur 1 gallon to 40 gallons of water, and the usual amount of arsenate of lead.

At present I do not feel like advising against the substitution of arsenate of lime for arsenate of lead with lime-sulphur, though I am not yet convinced that it is so safe. A warning, however, should be given, that some brands of arsenate of lime are much inferior to others and much less safe.

In a very wet period I should prefer Bordeaux to lime-sulphur for the spray just before bloom, because it will remain on the trees longer and thus keep off scab longer than lime-sulphur. I do not recommend it for the third application because it russets the fruit, some years very badly and every year to some extent.

As to the dropping of fruit which follows later applications of lime-sulphur in Nova Scotia, this has not taken place in Ontario in my own or any other person's experiments that I am aware of. I believe the difference in climate between the two Provinces accounts for the different results obtained.

As to the dust method of treating orchards, I do not intend to recommend it for the present. I have obtained good results from it myself but the fruit growers do not succeed well with it. They also object to the cost. The new spray guns have made them much better satisfied with liquid sprays.

Prof. Parrott: In our State I believe we have more pests to combat than you have in your fruit growing sections. We have San José Scale, and use lime-sulphur because it is cheap and nearly fool-proof from the standpoint of the farmer. We have the Pear Psylla, which is a very common pest in our pear growing sections, and we rely on lime-sulphur to combat that insect; and we have the various mites which are held in check by sulphur sprays. Considered from the standpoint of the dormant application we have to consider some spray mixture which will handle those particular pests.

Our change from Bordeaux to lime-sulphur was brought about by the attitude of our fruit growers. There was a period in the '90's and ten or fifteen years ago when growers suffered severe injury from Bordeaux mixture. As a result of this injury the farmers swung over to the use of the lime-sulphur, because the fruit presented so much better an appearance from its use. As far as New York is concerned (and I think I am safe in speaking for the men at Cornell as well of those of the New York Experiment Station) we would not dare to recommend Bordeaux to apple growers in our State; it causes too much injury.

I have been very much interested in the question of dropping of fruit. It seems to me it is one of the points which should be looked into. For two years we have carried on comparative experiments with lime-sulphur and arsenate of lead and Bordeaux mixture and arsenate of lead, and in 1917 we had a larger drop on the check trees than on those sprayed with lime-sulphur and arsenate of lead or Bordeaux mixture and arsenate of lead.

We tested nine brands of calcium arsenate this summer and also tested a formula given by our Federal Government for home-made calcium arsenate. In the work on the station grounds we had no injury, not even yellowing, in any plot sprayed with a commercial brand, notwithstanding the fact that we gave all four applications. We had, however, serious yellowing following the second application of the home-made preparation.

A point was made in regard to dusting. There is involved a consideration of the fact that in certain districts of New York the red bugs are a most injurious pest. We have no contact dusting material which favorably controls them. I doubt whether dusting will get very much encouragement the coming season.

INSECTS OF THE SEASON IN ONTARIO.

W. A. Ross, Dominion Entomological Laboratory, Vineland Station, Ont., and L. Caesar, Ontario Agricultural College, Guelph.

Orchard Insects.

San José Scale (*Aspidiotus perniciosus*). The severe winter of 1917-18 destroyed a very high percentage of the scale. Inspectors from all scale districts report less of this insect this year than for many years. In two Woodstock orchards infested for at least the past ten years, it has, so far as the Provincial Inspector could judge, completely disappeared, no live scale being found on fruit or branches in October.

Green Apple Aphis (*Aphis pomi*). During the summer there was a widespread outbreak of the Green Apple Aphis. In most orchards the infestation did not attain serious proportions until about mid-July, and from then on it was somewhat rapidly brought under control by hot, dry weather and by insect enemies, until by the second week of August comparatively few aphids were left on the trees.

In most cases no great damage was caused by the aphis apart from coating the fruit with the sooty honeydew fungus. Fortunately, most of this was washed off before picking time by heavy rains.

White-marked Tussock Moth (*Hemerocampa leucostigma*). In view of the abundance of the tussock moth egg masses on orchard trees last fall, the outbreak of this season came as no surprise. Apple and plum orchards throughout the Niagara District and Western Ontario were badly infested and much damage was done to the fruit.

Fortunately for all concerned, the tussocks were parasitized so heavily by hymenopterous and tachinid parasites that only an insignificant number reached the adult stage. We can safely look forward to next year as a season of comparative immunity from this pest.

Pear and Cherry Slug (*Caliroa cerasi*). During June and July, cherry, pear and plum trees in various parts of the Province were seriously injured by this insect. In many orchards the foliage, particularly of sour cherry trees, was almost wholly destroyed. At picking time much of the fruit on badly infested sour cherry trees was wizened, slug-eaten and unfit for sale.

A very large percentage of the second generation eggs were destroyed by a minute parasite, *Trichogramma minutum* Riley.*

Pear Psylla (*Psylla pyricola*). This pest was again very abundant in various pear orchards from Burlington to the Niagara River. It is worth while recording here that large numbers of trees which had been seriously injured by pear psylla in preceding seasons succumbed to the low temperatures of last winter.

Fruit Tree Leaf-roller (*Tortrix argyrospila*). This insect has apparently almost completely disappeared east of Toronto, but there are some indications that it may be on the increase in the south-western part of the Province. At Simcoe, it caused considerable loss to Greenings. At Ancaster, there are a good many egg masses, indicating that in this locality there will likely be considerable injury from the leaf roller next year.

*Species determined by Mr. A. B. Gahan, U. S. Bureau of Entomology.

CHERRY FRUIT FLIES (*Rhagoletis cingulata* and *fausta*). In the Burlington and Niagara Districts, the crop in some unsprayed orchards of Montmorency and Morello cherries was a complete loss because of the large percentage of wormy fruit.

The severe losses caused by the fruit flies last year induced nearly all the larger growers to spray this season. No sweetening was used, and in many cases a fungicide was added to the poison without detriment to the efficiency of the treatment.

A braconid parasite, *Opius ferruginea* Gahan,* was found in fairly large numbers ovipositing in maggot-infested fruit in an orchard near Jordan, and in another orchard at Burlington. The same species was bred from wormy cherries in late August and early September.

BUD MOTH (*Tmetocera ocellana*). East of Toronto and in parts of Western Ontario, the bud moth was very prevalent this spring.

LESSER APPLE LEAF-ROLLER (*Alceris minuta*). In September, a farmer of Bruce County wrote for information about a caterpillar that folded apple leaves over and fastened the edges together. Specimens were asked for but when he went to gather them on October 29th, he found the larvæ had deserted the leaves. This fact and the description given of the caterpillar and its work indicate almost without doubt that the species was *Alceris minuta*. The farmer stated that almost every leaf in the orchard was folded. The Lesser Apple Leaf Roller is not common in Ontario.

THE RED-HUMPED APPLE WORM (*Schizura concinna*), the YELLOW-NECKED APPLE CATERPILLAR (*Datana ministra*), and the FALL WEBWORM (*Hyphantria cunea*) were prevalent in the Niagara and Burlington districts.

THE PEAR THRIPS (*Taeniothrips inconsequens*). This species, hitherto unrecorded in Ontario, was taken on pear trees last spring in a large orchard near Beamsville. Fortunately, the thrips was present in very small numbers and apparently was not causing any appreciable injury.

It is highly probable that this insect has been present in the Niagara district for a number of years and has not been observed heretofore simply because it has never assumed economic importance.

INSECTS INJURIOUS TO SMALL FRUITS.

BLACKBERRY LEAF-MINER (*Metallus bethunei* or *M. rubi*). This miner, though very abundant last year, was even more abundant this year. Practically every leaf in several plantations had from one to fifty mines, and nearly all the older and lower leaves died and fell off in late July and early August. These were replaced by new foliage which in turn became mined in September. All efforts to control the insect failed. In experiments conducted at Burlington large numbers of adults were poisoned by spraying the leaves with sweetened arsenate of lead. It was found, however, that to be effective the spray would have to be applied daily for almost a month because the adults continued to emerge for about that long, and they were found to feed only upon the mixture before it dried, paying no attention to it after this.

In experiments with contact insecticides the sawflies were easily hit but even when drenched with kerosene emulsion, usual summer strength, or with whale oil soap 1 lb. to 4 gals., they recovered as soon as dry and were quite uninjured.

*Species determined by Mr. A. B. Gahan, U. S. Bureau of Entomology.

Last year many parasites were present but this year there were very few cases of parasitism seen.

STRAWBERRY WEEVIL (*Anthonomus signatus*). This species was unusually destructive in Halton County and in the Niagara district. In many strawberry plantations, especially in those adjoining wood-lots, from 30 per cent. to 50 per cent. of the crop was destroyed by this pest.

In a strawberry plantation at Vineland the depredations of the weevil were apparently completely checked by a heavy application of sulphur and arsenate of lead dust (80 parts of sulphur, 10 parts arsenate of lead, 10 parts filler).

STRAWBERRY LEAF-ROLLER (*Ancylis comptana*). At Burlington on July 25th many strawberry leaves were found infested with this roller and numerous moths could be seen flying over the plants late in the evening. All stages of the insect—eggs, larvæ, pupæ and adults—were to be found at that date. Comparatively little injury was done. Growers say that the insect, although common for years, has not caused much loss.

RED SPIDER (*Tetranychus bimaculatus* or *T. telarius*). During the latter part of July raspberry bushes in the Vineland district were seriously injured by the red spider.

INSECTS INJURIOUS TO TRUCK CROPS.

CABBAGE ROOT-MAGGOT (*Chortophila brassicae*). This pest has seldom been more destructive to cabbage, cauliflower and radish than it was this year. Complaints were received concerning it from all parts of the Province. In Carleton County considerable loss was caused on some farms by the maggots attacking and destroying young turnips.

ONION MAGGOT (*Hylemyia antiqua*). This insect, though not so abundant as the cabbage root-maggot, was present in considerable numbers in many localities.

SEED CORN MAGGOT (*Chortophila fusciceps*). Not nearly so many complaints of injury to beans from this maggot were received this year as last. Seed potatoes in the vicinity of Brantford were badly attacked. A few complaints of injury to beans, seed corn, and potatoes were received from other districts.

CABBAGE WORM (*Pontia rapae*). In the Niagara district this pest was unusually abundant.

BEET LEAF-MINER (*Chortophila vicina*). Numerous mines caused by this miner were seen at Guelph and Burlington on beets and a considerable number on mangels. On July 2nd many eggs were to be seen on the under surface of the leaves. Nearly all these eggs or the maggots from them must have perished, for very few mines were observed after that date.

PARSNIP WEBWORM (*Depressaria heracliana*). This species was decidedly destructive to the parsnip seed crop in parts of Western Ontario, and at Guelph and Vineland.

CARROT RUST FLY (*Psila rosae*). Specimens of carrots injured by this fly were received from Guelph, Fergus, Toronto, Shelburne, St. Mary's and Listowel.

CUTWORMS: Corn and garden crops suffered to a considerable extent from cutworm injury.

INSECTS INJURIOUS TO FIELD CROPS.

For the most part, field crops were injured very little by insects.

WHEAT INSECTS. The Wheat Midge (*Thecodiplosis mosellana* Gehin) which caused so much alarm in 1917 was not at all abundant this year. In rearing

cages at the Vineland Station Entomological Laboratory, adult midges emerged from June 18th to July 4th, most of them coming out about June 23rd and 24th.

While looking into the wheat midge situation, a slight amount of Hessian Fly (*Mayetiola destructor*) injury was noticed near Ridgeway, Welland County, and in two wheat fields near Beamsville, the Wheat Joint Worm (*Isosoma tritici*) in considerable numbers was found at work.

WIREWORMS. According to Mr. H. F. Hudson, the oat crop in Caradoc, Middlesex, was seriously injured by the wireworm, *Agriotes mancus*.

MISCELLANEOUS PESTS.

WARBLE FLY (*Hypoderma bovis*). Numerous complaints of cattle gadding were received. Farmers who had not previously seen their cattle stampeded in this way and who learned that a fly was the cause, became much alarmed lest the pest should increase.

It looks as if *Hypoderma bovis* were becoming more abundant and more widely distributed through the Province. In some districts, however, it does not seem to be present yet, for stock men in these claim they never saw their cattle gadding.

ROSE MIDGE (*Dasyneura rhodophaga*). This undesirable alien, already well established in a large rose garden near London and in Toronto greenhouses, has invaded another part of Ontario, viz., Port Dover, where it was found this year at work in Messrs. Ivey & Sons' greenhouses.

In order to prevent the further spread of the midge, the following recommendations have been made to florists:—

(1) Whenever possible, growers should propagate their own roses.

(2) New stock should be obtained from non-infested greenhouses.

(3) Rose plants and scions purchased through commission houses or from places not known to be free of midge, should be imported before the end of February. This recommendation is made because such stock, provided it has been planted in November or December, will not have been exposed to infection.

(4) Greenhouse roses brought in later than the end of February should be carefully examined for rose midge injury, and any infested plants should be destroyed. In addition to this, the soil should be washed off the roots of the plants and should then be thrown into the furnace or scalded with hot water or steam.

ROSE LEAF-ROLLER (*Cacoecia rosaceana*). During March this insect was remarkably abundant on roses in a Toronto greenhouse.

NEMATODES. Cyclamen were seriously injured by Nematodes in a Hamilton greenhouse. The species concerned was not determined.

CHERMES. The galls made by *C. abietis* and *C. similis* were more conspicuous on spruce trees this season than they have been for several years.

LADYBIRD BEETLES. *Coccinella 9-notata* and *Adalia bipunctata* were remarkably common this year. The latter species was very frequently found in large numbers this fall in dwelling houses in the Niagara district.

POWDER POST BEETLES (*Lyctus striatus*). This beetle was found infesting and seriously injuring oak floors, base-boards, and an oak cupboard in a Vineland house. Some of the wood in the cupboard was badly worm-eaten. A species of Lyctus was also found injuring woodwork in a church in Hamilton.

PROF. PARROTT: I should like to hear from Mr. Ross regarding the distribution of the pear thrips. We find it both on pears and apples in Western New York. So far, it has only been injurious with us in the Hudson River

Valley. There it is very destructive and is found in varying numbers from season to season.

Mr. Ross: This season I found the thrips only on pear and in only one locality—Beamsville. Next year I am going to look into the question of distribution more thoroughly. I should like to ask Mr. Davis if he can tell us anything about the Rose Midge.

Mr. Davis: I cannot tell you any more than what little I have published.

Mr. Ross: Do you know if it occurs all over the United States?

Mr. Davis: Everywhere east of the Mississippi River. In connection with the control of the midge, what you and others have published is all that is known concerning it.

Mr. Ross: Mr. Sasscer of the U. S. Bureau of Entomology obtained absolute control in a Baltimore greenhouse by fumigating with tobacco smoke and at the same time covering the soil with tobacco dust. He fumigated the house as long as the adults were seen. He also sprayed the sidewalks with kerosene emulsion

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INSECTS OF THE SEASON IN QUEBEC DISTRICT, 1918.

Geo. Maheux, Quebec.

The summer of 1918 may be considered normal, as regards the insects injurious to cultivated plants. We did not have to register any real plague, and the common insects only appeared in rather small numbers. Only one pest appeared to have increased in numbers, and this one has worked more damage than usual in this district; it is the potato flea beetle, *Epitrix cucumeris* Harr.

On the other hand, the Colorado potato beetle, although well represented, shows a decrease compared with 1917. Certain districts in the northern part of the Province, such as the Lake St. John district, were visited by only a few individuals. It is advisable to note here that if the severe winter we have had has contributed to the partial bankruptcy of the multiplication of pests, it is equally important to emphasize the fact that for two or three years the use of insecticides and sprayers has spread considerably. Moreover, the inquiries we are receiving throughout the summer from farmers, and which are continually increasing, show the importance that the latter now attach to the question of the protection of plants. We consider as a remarkable improvement the fact that at least 80 per cent. of farmers use an efficient insecticide for their potatoes. The sale of sprayers yearly increases in a wonderful manner, and before long the great majority of farmers will own a good spraying machine.

The potato flea beetle, *Epitrix cucumeris* Harr., bored through the leaves of tomato plants as well as potatoes, but the other vegetables only suffered an occasional injury. Poison sprays check them rapidly.

The various Cruciferae of our gardens have had to stand the attacks of numberless cabbage worms (*Pieris rapae* L.). It was, without any doubt, the most injurious pest of the season. Much difficulty was experienced to gather cabbages and cauliflowers that were not infested. The cabbage maggot (*Phorbia brassicae* Bouché) like the cutworms, caused only insignificant damage.

In most of the war gardens, which had been fallow lands for a long time, potatoes were injured by white grubs (*Lachnosterna* sp.); 10 per cent. of the crop was spoiled for this reason.

In a few places, the Zebra caterpillar (*Ceramica picta* Harr.), the corn maggot (*Phorbia fusciceps* Zett.), the pea weevil (*Bruchus pisorum* L.) made themselves known, but without causing any serious loss.

Aside from injurious insects, slugs showed up in large numbers and worked considerable havoc in bean crops, which failed in many districts.

The only insect on fruit shrubs worth mentioning was the imported currant worm (*Pteronus ribesii* Scop.), which destroyed a number of currant and gooseberry bushes. On the other hand, the currant aphis (*Myzus ribis* Linn.), which was very numerous last year, was hardly represented this year.

Satisfactory conditions prevailed in orchards; very few apple aphis, a few caterpillars,*Datana ministra* Dru., *Schizura concinna* S. & A., and *Hemerocampa leucostigma* S. & A., the latter being the most numerous. As regards the rest, conditions were about normal. A good many tussock moth caterpillars were noticed on ornamental trees, as well as a few spiny elm caterpillars (*Vanessa antiopa*).

APHIDS; THEIR HUMAN INTEREST.

A. C. Baker, Washington, D.C.

The aphids, or as they are commonly called, plant lice, are among the most interesting of all insect forms. Their importance from several standpoints only adds to the interest which their peculiar habits arouse and their wide distribution and abundance force them on the attention of all those who are in any way interested in plant growth. Thus the early philosophers were attracted by these curious insects and were at a loss to understand their origin. Some claimed they were engendered of the dew, others that they developed from the waste products of ants.

The galls produced on plants by certain species are among the principal ingredients in the manufacture of inks and dyes. Galls of *Melaphis chinensis* are known on the market as nut galls or Chinese galls, and are used almost exclusively in some of the secret methods of sealskin dyeing. The trade in these galls alone reaches into the millions of dollars annually. The galls of this species were known and used by the Chinese many years before Europe learned of them and a rather extensive account is given in the Pên tsao kang mu. They are gathered, steamed and dried and are then ready for shipment. Galls of certain species of *Pemphigus* have been used for many years in Syria, China, etc., for the preparation of bright colored dyes for the fine silks which we value so highly, and these galls are listed on the market at a high figure. Some of the better known ones have been imported into this country and Europe but a large number of species remain yet unstudied and the uses to which their galls may be put are as yet unknown.

Most species produce in large quantities the substance known as honeydew. This is merely the excrement of the aphids, and not, as is very often supposed, a secretion of the cornicles or so called honey tubes. This substance has been known for many centuries, but its origin was in the early days not understood. Pliny speaks of it as the sweat of heaven or the saliva of the stars, and it was not until fairly recent times that its true nature was made known. The substance was gathered, however, in large quantities. The Arabs used it on their cakes much as we have all used honey in our boyhood days, and it is used in parts of the world as a medicine. In France it has been employed by the peasants

in diseases of the chest, and it has also been claimed to cure certain affections of the eyes. In Italy it has been used as a salve for the treatment of wounds and sores.

Honeydew is gathered and stored in large quantities by bees at certain seasons of the year when the nectar flow is low. While this is a disadvantage to the beekeeper in that he can not dispose of it, under the present laws, as pure honey it has the advantage of making available, with little expense, large quantities of honeydew. At present in this country the honeydew thus secured is nearly all used by our bakers in the making of cakes, etc. It is, however, a source of some of our rare laboratory compounds, and no doubt in the future will be used in the manufacture of products formerly imported at a high price, for it is available in large amounts. It is interesting to note that the cornicles were so long associated with honeydew. Morren[1] even claimed that they were employed in giving nourishment to the newly born young much in the way that the mammary glands supply nourishment to young mammals.

In recent years aphids have been associated with the transmission of important plant diseases. Prof. D. H. Jones[2] early indicated by his experiments that aphids are one of the factors in the transmission of pear blight. In connection with disease like mosaic and spinach-blight apids have been credited with an important role but the study of the relation of these insects to plant diseases is as yet in its infancy.

It is claimed by some workers that large numbers of certain aphid species on forage plants are responsible for the injuring of cattle. In China and other eastern countries, on the other hand, some of the galls have been employed as food and as native medicines. In medicine they are employed chiefly as astringents, although they have also been used in other ways.

The relations between ants and aphids have been a favorite subject of study. In return for the honeydew many ants take great care of aphid colonies, building shelters for them, protecting them from their enemies and transferring them when necessary to new feeding grounds. Some even carry the young above ground during the warm sunny hours in spring and return them to their nests for the night. The writer has supplied ants with several hundred wingless aphids and watched these insects distribute them over the most tender feeding areas of a young tree there to start new colonies.

The peculiar habits of the species afford a field of study paralleled in few other groups. Alternation of hosts is commonly met with, and this habit adds to the difficulty of tracing life cycles. Some species on their primary hosts are remarkably different in structure from the same species on their alternate hosts. The writer has found that if species can be made to live on one host, forms which normally show characters associated with a secondary host will develop the characters, in part at least, of the forms occurring on the primary host. Thus races may be reared which have a definite relation to a given host and quite a definite structure. In some cases these races become more or less fixed after long periods, and it is with the greatest difficulty that they are again established on their original hosts. When this is done they ultimately reassume the characters associated with their original hosts.

The presence of winged and wingless forms has given rise to studies on wing production. This subject has been attacked from several standpoints. The

[1] Morren, Chas.—Ann. des Sciences Nat., 1836.
[2] Jones, D. H.—Bull. Ont. Agr. Coll.

occurrence of definite intermediate forms was pointed out by W. F. Turner[3] and the writer. These forms retain the wings in a more or less rudimentary condition and they tend to lose also the other characters which are associated with the winged form. In some species like *Aphis pomi* DeGeer, it is possible to rear an almost pure apterous line and a line with a high percentage of winged forms. It is noteworthy that in certain aphid groups it is impossible to rear apterous forms while in the more specialized groups the winged forms are often absent for many generations. Sometimes a species may be reared for 100 or more generations without a winged insect appearing. It is thus evident that in the family nature has eliminated the wings to a large extent in the specialized groups.

Search has been made for the controlling factor here and several different ones have been claimed. Ewing[4] worked from the standpoint of temperature and in *Aphis prunifoliae* Fitch (*avenae* of authors) was able to control the winged condition by varying the temperature. This species is one like *pomi* in which both winged and wingless forms are common. Ewing also obtained intermediates (calling them paedogenetic nymphs), adults between the winged and apterous condition. Several factors were not considered in his experiments. The affect of varied temperature on the availability of food and its nature when available was not ascertained and the genealogy of the specimens tested was apparently not considered.

Gregory[5] worked with *Macrosiphum pisi* L., and obtained control by varying the food in the previous generation. With insects from different regions, however, she obtained slightly different results. Her experiments were conducted without a definite temperature control and without considering the descent of her insects.

Shinji[6] has made experiments in feeding different chemicals to aphids and finds that he can define two groups of compounds one of which will result in the development of a high percentage of winged forms and the other of which will prevent wing development. His work follows that of Clark[7] and is very interesting. It is noteworthy, however, that his experiments as recorded were conducted almost altogether during fall, winter or spring, and he gives no records of the ancestry of the specimens whereby we can judge of the percentage of winged or apterous forms which would normally be expected from the individuals treated. The writer has found that in some cases the offspring of an individual will be nearly all winged or apterous at the beginning of the period of reproduction and the reverse toward the end of the period. It is important to remember that Shinji was unable to produce any apterous forms in the aphid groups which have not yet eliminated the wings. That is, the ancestry of these forms was more important than his wing preventing substances. On the other hand, in groups which are nearly all apterous he did not experiment with his wing producing substances. It is curious that tannin is listed as preventing wing development and yet several species develop wings while feeding on galls containing 60 per cent. of tannic acid. On the other hand, sugar is given as a wing producing substance and yet the writer has reared an apterous line of *Eriosoma lanigera* for two years on galls containing an abundance of sugar. That Shinji overlooked some factors is evident for he says "*Macrosiphum rosae* also produced alate forms

[3] Turner & Baker—Proc. Ent. Soc., Wash., XVII, No. 1, 1915.
[4] Ewing, H. E.—Biol. Bull., XXXI, No. 2. 1916.
[5] Gregory, Louise H.—Biol. Bull., XXXIII, No. 4, 1917.
[6] Shinji, George O.—Biol. Bull., XXXV, No. 2, 1918.
[7] Clark, W. T.—Journ. Tech., U. of Cal., I, No. 3, 1903.

even on a relatively younger shoot but it is utterly impossible to raise winged *Myzus persicae* on a similar host without the application of a wing developing substance." The writer has reared very large numbers of *persicae* on just such an host without the application of any such substance, and has repeatedly obtained 90 to 100 per cent. winged. But this was where winged forms would be expected in the line in large numbers.

The peculiar life histories of members of this superfamily have led to studies on the predetermination of sex. Morgan,[8] for example, has shown that in *Phylloxera caryaecaulis* there are two types of males depending on the fate of one of the small sex chromosomes when the polar body is about to be produced. Each of these males thus produces a different type of spermatozöon, one female producing and one male producing. If the sexual egg is fertilized by the female producing spermatozöon the resulting stem mother will give rise to the line which results in the sexual female. If it is fertilized by the male producing spermatozöon the resulting stem mother will give rise to a line which results in the production of the male. It is thus seen why we have two types of stem mothers, one giving the large egg migrants and the other small egg migrants.

The production of plant galls by aphids has given rise to studies on these modifications of plant tissues and attempts to determine the factors at work. In some instances it has been claimed that the agent might be an enzyme present in the saliva for in such galls as those of *Eriosoma lanigera* the normal starch is replaced by sugar. The gall makers, too, have led to observations on the sensory organs of aphids. Those species which inhabit galls as well as many of the subterranean species have larger and more prominent sensoria on the antennae than have other species. These are in striking contrast to the sensoria on the antennae of the solitary and free-living forms. The gall formers and subterranean forms also have a larger number of Hicks organs or olfactory pores on the wings than do the solitary species.

Much interesting work has been done on the relation between aphids and their parasites, both animal and plant, and their predators. It is claimed by some workers that certain lower forms are associated with aphids in a commensalistic relationship and may be even passed from one generation to the next through the egg. Many of the parasites so reduce the numbers of aphids that a species otherwise very destructive need scarcely be considered.

Finally certain aphids are among the most injurious species of insects with which the farmer has to deal. The woolly apple aphis for example, had become so important even in 1832 that the Académie de Rouen offered a gold medal for the working out of its life history. The outbreaks of *Toxoptera graminum* in the grain growing areas of the world have done enormous damage and it is only necessary to watch the exchanges to see the influence this one insect sometimes has in the business world. In one outbreak according to Rondani the swarms of aphids appeared like dark clouds and later their dead bodies covered all the streets of the city.

It is thus seen that aphids have a very vital human interest. They supply materials worth much to the arts. They furnish certain quantities of food. And they have given the clews which have resulted in the working out of important biological problems. On the other hand they contribute some of our worst enemies of agriculture. But in our fight against these species we are aided by natural factors without which many of our important crops would be impossible.

[8] Morgan, T. H.—Journ. Exp. Zool., XIX, No. 3, 1915.

THE PRESIDENT: I am glad Dr. Baker sent us this paper. It is one I am sure all of us will be glad to read over at our leisure. I should like to ask Dr. Matheson if the woolly aphis is of much importance in New York State. In Ontario it is certainly of minor importance.

DR. MATHESON: I hesitate to answer your question for New York State, for I have not done very much on the woolly aphis. I do not think it is a very important factor except in some nurseries on sandy areas.

PROF. PARROTT: Dr. Matheson has expressed the economic status of the insect so far as New York is concerned. Our attention to the work of the woolly aphis is usually called by its presence in young orchards of five, six or seven years of age which have not received any spraying. This refers to the aerial and not the root form. It is very seldom our attention is called to its work on the roots of nursery trees. From our correspondence it does not appear to attract a great deal of attention.

I think we owe a great deal to the entomologists of Canada for the work which has been done on the cherry aphis. I am referring particularly to the work of Mr. Ross on the ultimate hosts of the insect. This has been a great aid in our studies.

PROF. BRITTAIN: The woolly aphis is of practically no importance in Nova Scotia.

THE PRESIDENT: I think we in Canada and New York State hardly appreciate the advantage we have over States farther south regarding woolly aphis. It is one of the worst pests of the States to the south. I know in Ontario of only one or two cases where the woolly aphis has been found in nurseries attacking the roots.

DR. HEWITT: The woolly aphis has proven to be quite a serious pest in British Columbia, where we get the root form as well as the aerial form. There was one point which Dr. Baker raised in his paper, which leads to an interesting biological phenomenon which it would be well for all of us to bear in mind when we are carrying on our studies, and that is the possibility of the formation of races of insects. During the last year we have found in British Columbia what is evidently a distinct race of the apple maggot on the Snowberry, which is used as an ornamental shrub. Wherever we found this shrub, whether in the south or farther north, we got this infestation by the apple maggot, though apples in the vicinity were not attacked.

SOME INSECT PROBLEMS IN THE PRAIRIE PROVINCES.

NORMAN CRIDDLE, ENTOMOLOGICAL LABORATORY, TREESBANK, MAN.

Conditions in the Prairie Provinces are, as a rule, so totally different from those of Eastern Canada and the problems we have to contend with differ so much in general, that in reality they are often only alike in the broad outlines to which all insect problems must be approached. Take for instance, the general trend of these meetings; the papers and discussions lean decidedly towards the problems of fruit insects and insecticides, whereas in the West you would find fully 75 per cent. related to field crop insects and few indeed to those of fruits or sprays. To us these last are of quite secondary importance, and instead we have to deal far more with poisoned baits and methods of cultivation. Another point, and this

has often led to misunderstanding, is that of presuming because an insect occurs across the continent, that it is therefore identical in its life habits throughout its range. As a matter of fact very few are. This was brought prominently to my notice during some recent studies in white grubs (*Lachnosterna* spp). In the east and southward through Indiana, where Mr. J. J. Davis has made such a thorough study of these insects, the life cycle is usually three years, whereas in southern Manitoba it is four years. Now supposing we had studied only the eastern habits and applied them to the west, we should be a year out in our prognostication. It is of interest to note here that I found a similar variation in the life cycle of tiger beetles (*Cicindela*) as compared with habits worked out by Professor Shelford at Chicago. I am also of the opinion that we shall find the habits of some of our wireworms to differ in the same way. Another example may be found in the Hessian Fly, though in this case it is simply a matter of a reduction in the number of generations.

In the past there was a general tendency to supply the habits of old world insects to those of the new and occasionally we find an instance where this is still marring our progress. An example of this occurs in a well known pest of the Prairie Provinces, namely, the Western Wheat-stem Sawfly, *Cephus cinctus*. This insect was originally confused with the European *Cephus pygmaeus*, consequently as no further studies seemed necessary at that time, the old remedies were recommended, and are in some instances still, in spite of the fact that every effort has been made to show that they do not apply.

It might be asked, what are the outstanding differences that so alter the habits of identical insects. There are several, but the chief ones are those of climate; greater extremes of temperature, especially on the downward trend in winter, and less precipitation. I have already shown how lack of snow is responsible for the destruction of a large percentage of our Colorado potato beetles. We had another remarkable instance of this last winter, which in the vicinity of my home near Treesbank, Man, was responsible for a total extinction of the species. Thus it will be seen that our frosts are of some value after all. Incidently I may mention that these same invigorating winters have proved an important factor in restricting another invader, namely the brown rat. The chief inclination of our climate, however, is to prolong the life cycle and this seems a general rule where native species are concerned.

The study of climate and meteorological changes in relation to animal life is a most interesting one and also important. Occasionally even a native insect gets caught by abnormal conditions of weather of which we had an instance last spring when a serious lepidopterous tree pest was reduced to quite insignificant proportions through the actions of a belated storm cutting off the food supply. I remember what promised to be another instance some years ago during a severe locust outbreak. The young hoppers had been hatched about two weeks when along came a severe snow storm accompanied by frost. Naturally the prophets predicted a total extermination of the plague, but like some well-known weather prophets their predictions were not verified, in other words, the locusts were in no way affected.

Since we do not grow apples to any appreciable extent, nor are much troubled by other fruit pests, we are able to concentrate largely upon cereal insects and those attacking root or vegetables. The field for this work is a very large one as can well be imagined when it is known that Saskatchewan alone had more than 22,000,000 acres under crop in 1918.

There are many different pests taking toll from these crops, six of which have been especially noteworthy in the past. They are: The Western Wheat-stem Sawfly, *Cephus cinctus;* Grass-stem Maggots (*Oscinidae*); Hessian fly; Wireworms; Locusts and Cutworms. Five of these are native species which before the advent of farming occupied their allotted space in the scheme of nature just as any other harmless creature might do. As usual, however, man upset the balance of things in his attempt to increase production and in doing so provided an unlimited supply of food for these insects. Thus we have the Western Wheat-stem Sawfly spreading from wild grains to cereals and what is almost as important, in most cases, leaving their natural enemies behind them. In their former state they were kept in check by two agencies, namely, lack of flowering stems in which they bred, or parasitic enemies. Under present conditions it would seem as if both these checks had been overcome and there remains, therefore, but one means of keeping them under control, namely, deep, well-turned, packed ploughing done either in the fall or before June of the following year.

The grass-stem maggots embrace many species and include such well known pests as the Greater Wheat-stem Maggot (*Meromyza americana*), Frit Fly (*Oscinis frit*) and many more. There is much variation in the life-history of these flies. Some are very injurious, others become so at times, while yet others actually do good. A few years ago less than a dozen species were known from Canada but within the last three years many more have been discovered including several that are new to science. The life of these flies is extremely variable. Some produce several generations in a season, others but one, while some again, pass the winter in the adult stage, others doing so as larvæ. They are by no means all grass feeders and some prefer decaying matter to living. Thus there is endless variation in their habits and much to be learned concerning them.

The Hessian fly is the only one of those mentioned that is not a native of our country and as is the case with many of our introduced animals it is subjected to inconveniences at times, through our variable climate. We have had seasons when fully 40 per cent. of the crop was injured by this insect, but its attacks, as a rule are few and far between, due chiefly to a lack of humidity at critical periods of the insect's life. In other words moisture is an essential factor in the insect's increase, while dryness reduces it to insignificance. Thus it is only during wet seasons that we have to be on our guard for possible outbreaks. Indeed, we have had but two severe infestations in thirty-five years.

Wireworms are with us always, but as is their habit elsewhere, they perpetuate most freely in grass lands. Several species are involved in our losses, the life habits of which are little known, but the average investigator is not anxious to undertake their study owing to the length of time it takes to rear them through all their stages. I personally have had an individual under observation for three years and it has hardly grown in that time.

One of the greatest scourges we have to contend against is that class of insects known as cutworms. They are always present. Sometimes in one part, at others in another. They come and go, but there are so many species involved that the farmer is often at his wits' end to know what to do. When the outbreaks are excessive large areas are swept off, much as army-worms would clear them. Thus hundreds of miles of territory may be involved. At other times the outbreaks are quite local but we are never wholly free from them and in gardens they are a permanency. There is much variation even in the life of these insects. Some deposit their eggs upon weeds, others in or on the soil. Some hatch from eggs the

same season, others do not do so until the following spring. They differ, too, in other ways but in appearance the general colour scheme is so similar that it is not surprising if the farmer fails to differentiate between one kind and another. Even the most experienced are puzzled at times owing to the sudden increase of a previously rare species. I had an example a few months ago when I received a consignment from Alberta. The species involved looked very like an insect to which my colleague Strickland had devoted such profitable attention a few years ago, namely, the army cutworm, but the larvæ seemed too large for the time of year, besides being considerably farther north than usual. However, the fact remains that they were very numerous and that they give every promise of causing injury next spring.

The last on my list is locusts. Probably all have read of the time in the seventies when an old enemy, the Rocky Mountain locust (*M. spretus*), came in millions and devoured all in sight. It was before my time but eye witnesses tell me that not a leaf remained and that the insects suddenly commenced to drop from a clear sky and were soon falling as a severe snowstorm does. The species is not, however, a native of our prairies: consequently, while it may breed for a season or two in millions, the time must come when the climate proves unsuitable and so they perish. Unfortunately we have several native species almost as destructive. One of them the Lesser Migratory Locust (*M. atlanis*) has on more than one occasion caused serious damage, while several others assisted materially in the depredations. A few dry seasons are generally sufficient to increase them to injurious numbers and even when the weather proves unsuitable close at hand they readily fly from elsewhere, consequently an outbreak a hundred miles or more away may easily lead to one close at hand.

I need hardly add in conclusion that there are many other pests requiring attention and we are never sure when others will appear. Army worms, aphids, tree pests and those of live stock all provide their periodic outbreaks and thus while our problems are seldom fruit ones, we have, nevertheless, much to keep us occupied.

THE RECOVERY IN CANADA OF THE BROWN TAIL MOTH PARASITE *COMPSILURA CONCINNATA* (DIPTERA, TACHINIDAE.)

John D. Tothill and Leonard S. McLaine, Entomological Branch, Ottawa.

With considerable truth Oliver Wendell Holmes remarks that all boarding houses are the same boarding house. He means by this that there is a monotonous sameness about all of them, and that to know one of them is to know all of them. Until about a decade ago it was thought that tachinid flies resembled boarding houses in the monotonous sameness of their activities and that to know one of them was to know all of them. We were shaken out of this rather comfortable notion chiefly through the work of Pantel in France and Townsend in the United States who showed that these two-winged parasites exhibited among the different species a highly diversified and interesting set of methods for attacking their victims and gaining a livelihood.

One of the species studied by these authors was *Compsilura concinnata* the little fly that forms the subject of the present paper. As to its method of attack it was found that instead of depositing a large egg upon the skin of the victim—the method of the bourgeoisie among the tachinids—it placed a fully developed maggot

in the wall of its mid-intestine. This it was enabled to do by reason of a piercing ovipositor, beautifully adapted for the purpose. Moreover, this fly was found to be one of the chief factors in the natural control of the brown-tail and gipsy moths in Europe.

With characteristic energy the United States Government, through Messrs. Howard, Fiske, Townsend and Burgess, took steps to introduce this parasite into the New England States where the gipsy and brown-tail moths were creating such havoc. The story has been told of the collection in Europe of thousands of these parasites and of their liberation in Massachusetts, and of how after several years of anxious waiting the species was finally recovered and known to be breeding on American soil. It has also been related that with almost incredible swiftness the fly increased in numbers so as to take its place in the American fauna as one of the most potent factors in the control of the two insects it was expected to attack.

Fig. 2.—Compsilura adult. This excellent parasite of the Gipsy and Brown-tail Moths is now established in Canada. (After the U.S. Bureau of Entomology.)

When the brown-tail moth spread into Canada the country was confronted with a situation demanding immediate action, and the Dominion Entomologist arranged not only for a field campaign against the invader but also for the introduction from Massachusetts of its natural enemies.

The question of what to introduce into the Canadian brown-tail moth area had to be thought over very carefully, because it was realized from the first that our Canadian problem differed in important respects from the New England one. The fine beetle Calosoma was available and was colonized rather as a safeguard against a possible outbreak of the gipsy moth than in the hope of its being of immediate assistance in our brown-tail moth situation; for like most predacious animals it can increase only when the food supply is abundant. An Apanteles which was available had done fairly good work in Massachusetts and was also brought across the international boundary in the hope that it might live in our more rigorous climate and be of equal usefulness. The insect, however, that seemed to warrant almost any amount of effort to introduce was our little friend *Compsilura*.

We needed a parasite that could live upon native hosts as well as on our

brown-tail moths—preferably something with two or more generations a year so as to insure a rapid increase. We also needed something that would develop its greatest usefulness against the Brown-tail Moth while that host was still relatively scarce. All these attributes were possessed by *Compsilura* and the work of importation began with hopes running high for the success of the venture. What we did not know, of course, was whether this fly could live under boreal conditions, where the climate is so much more erratic and severe than in France and Massachusetts.

Seven years ago, in 1912, two colonies of *Compsilura* were liberated in New Brunswick strong enough and under good enough conditions to warrant recovery speculations. The next year, however, no *Compsilura* could be recovered from the colony sites and the work of importation had to be continued. At first there was no occasion to worry about the non-recovery of *Compsilura,* for it had taken three years to prove establishment in the United States. However, being human we worried a little and increased our efforts to secure more material for liberation. After four years of colonization, without apparent results, we redoubled our efforts

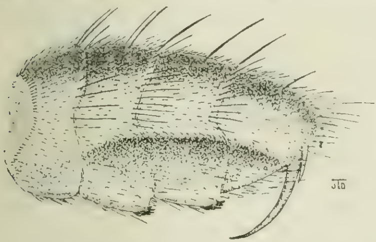

Fig. 3.—Abdomen of female *Compsilura* showing piercing device. The ventral part of segments 2, 3 and 4 is flattened into a keel shaped structure. Note the clusters of spines on segments 2 and 3 that have been developed for holding the caterpillar when using the piercer. (Original.)

Fig. 4.—Piercing device of female *Compsilura*. With this hollow, sickle-shaped instrument (1 m.m. in length), the female fly punctures the skin of a caterpillar. With her somewhat inconspicuous larvipositor she then places a maggot in the wound after which she flies to another victim. (Original.)

to secure a large number of flies. Host caterpillars were collected in great quantities in Massachusetts and a very large number of the flies were bred out for liberation, as the chart shows, in Nova Scotia, New Brunswick, Quebec and Ontario.

At the close of that year, 1916, it was felt that every opportunity had been given *Compsilura* to become a part of the Canadian fauna—in a period of five years about thirty thousand flies had been liberated—and the work of importation was consequently stopped.

In 1917 a considerable amount of energy wes expended in the attempt to recover this elusive fly, but once again the results were discouraging. This year (1918) the recovery work was continued and the insectary at Fredericton filled with thousands of tussock, datana, and red humped larvæ, collected from likely places in Nova Scotia and New Brunswick. One day Mr. Keenan, who had charge of the tray work, brought in several dozen tachinid puparia bred from tussock larvæ collected at Fredericton. Among these were five little puparia that had the ear marks of *Compsilura*. With the same sort of tender solicitude that worker ants bestow upon larvæ just stolen from a nearby colony, we watched over these five puparia. After a week or two of anxious waiting five flies emerged; three were males and two females and all were *Compsilura concinnata*.

As the last liberations had been made in 1916 it followed that this parasite had successfully hibernated through at least two New Brunswick winters, and that it could now be considered a thoroughly established member of our fauna.

It has taken seven years to bring about the establishment of this parasite. The comparatively low cost of introducing this and other parasites of the brown-tail moth has been largely due to the splendid co-operation offered at all times by the United States Bureau of Entomology, particularly through Dr. Howard and Mr. Burgess who afforded the Entomological Branch every facility for carrying on the work of collecting material in Massachusetts and other parts of New England.

By way of conclusion it may be pointed out that Compsilura is now a national asset of considerable importance. As a parasite of the brown-tail moth it has already proven its worth in Massachusetts—especially in areas where the moth is not very abundant. It is also a splendid parasite of the gipsy moth both in Massachusetts and in Europe, and the cost of introduction would be much more than justified if only as a measure of security against a possible invasion by that despoiler of deciduous trees. In Massachusetts it has also proved to be one of the most, if not the most, effective enemy of the white-marked tussock—an insect now so conspicuous in many Canadian cities. That it is continuing this good work is shown by the fact that our five recovered specimens were all bred from white-marked tussock at Fredericton.

DISTRIBUTION OF THE PARASITE *COMPSILURA CONCINNATA* IN CANADA

NUMBER OF INDIVIDUALS LIBERATED

—	1912	1913	1914	1915	1916
Fredericton, N.B	1238	....	1500	1500	....
Harvey, N.B.	....	....	2000	....	....
Keswick, N.B	....	....	....	1800	....
Lower Woodstock, N.B	....	....	....	....	1200
Nerepis, N.B	....	1500	....	....	....
Oromocto, N.B	....	....	....	....	1200
Pokiok, N.B.	....	....	....	....	1200
Rosborough, N.B.	....	....	....	....	1200
St. Stephen, N.B	1119	1500	....	....	....
Temple, N.B	....	....	....	....	1200
Upper Gagetown, N.B	....	....	....	....	1200
Woodstock, N.B	....	....	1500	....	....
Annapolis Royal, N.S	....	....	....	1500	....
Bear River, N.S	....	1500	....	....	....
Ayer's Cliff, P.Q.	....	....	....	....	1200
Coaticook, P.Q.	....	....	....	....	1200
Stanstead, P.Q	....	....	....	....	1200
Way's Mills, P.Q	....	....	....	....	1200
Vineland, Ont	....	....	....	....	1200

SUMMARY.

Compsilura concinnata is one of the most important enemies in Europe and Massachusetts of the brown-tail and gipsy moths.

Between 1912 and 1916, inclusive, about 30,000 of these flies were collected in Massachusetts and liberated in the Canadian Brown-tail Moth area.

The parasite was first recovered in Canada in 1918—seven years after the first colony liberated—and can now be considered as established in New Brunswick.

Compsilura is now a national asset of considerable importance. It is a most efficient parasite of the brown-tail moth; affords protection against a possible invasion of the gipsy moth; and is already attacking in Canada the white-marked tussock.

EVENING SESSION.

On Wednesday evening, at 7.30 o'clock, a public meeting was held in Massey Hall, Ontario Agricultural College. Dr. G. C. Creelman, the President of the College, welcomed the members, delegates and visitors to the institution. Mr. F. J. A. Morris then gave an entertaining account of the "Life-history of a Hobby-horse," which was followed by the special address of the evening, on "Some Present-day Problems in Entomology," by Mr. J. J. Davis of West Lafayette, Ind.

At the close of this meeting a smoker was held at Dr. Creelman's residence.

THE LIFE HISTORY OF A HOBBY HORSE.

Francis J. A. Morris, Peterborough, Ont.

Part I (aet. 3-13).

Before I was three years old, so my elders and betters have informed me, I made my escape one day from the nursery and was caught in the garden crawling through a thicket of laurels. On being haled back to captivity by the nurse, I disclosed to her horrified gaze, clutched in one grubby paw, a happy family of "wee beasties" as I called them—an earwig, a "woolly-bear," a centipede and two "slaters" or sow-bugs, which I had collected on this my first entomological trip.

Some two years later, while staying at the seaside near Ailsa Craig, I called one day to an older sister who was hurrying down by me, to know if I might play with a pretty fly I had discovered on the staircase window: she was too busy with some private quest to do more than throw me a careless "yes, certainly," and pass on without turning to examine my playmate. The pretty fly, which was large and banded with yellow and black, so resented my stroking it that it backed down suddenly on the end of my finger, and I was removed howling to the kitchen to have my first wasp sting treated with washing blue.

It was from here or from Stonehaven, south of Aberdeen, where we stayed the following summer, that I brought home a whole chestful of shells gathered on the beach and a scrap book of variously tinted seaweeds. These two visits to the coast made a lasting impression on me, and for many months must have coloured my inland life with the bright hues of romance: for, one day, I rushed into the house from bowling my hoop along the highway, my eyes bulging with excitement, to announce that I had just seen a crab hopping along the Gilmerton Road. As we lived in the heart of Strathearn, 30 miles west of Perth, I presume the crab was a toad.

Children notice very small things, but their looks, I believe, are far from critical. At any rate I had never thought of counting the legs of crabs and frogs, either out of curiosity or from a sense of precaution: though, I well remember how I tried with a brother of mine to count the legs of a centipede after being told what its name meant. But, beyond all question, at the stage when we are ourselves still quadrupeds and creeping face downwards, like reptiles, over the surface of the earth, nothing is too small to be noticed.

It was in these days—i.e., before I had grown up into a biped more or less star-gazing—that I made the acquaintance of certain minute spiders known to those in sexless garments as "soldiers," and the name seemed very appropriate, for they were bright scarlet and bore on their back the distinct impression of a knapsack. "Clocks" and "jumping-jacks" were also among the marvels of what to every child is a new world full of all kinds of wonderful sights and sounds; "jumping-jacks" were a small elater or click-beetle, and "clocks" were weevils with a stupendous power of grasping and clinging in their six pairs of toes. Another mystery we soon got to the heart of was the little blobs of spittle that appeared on the stems of meadow-grass where we played; and at the core of these queer little froth-cocoons we found the tiny atomy that makes them, still spitting for all its life was worth. Quite a formidable monster in this nursery land, I remember, was the "devil's coach-horse," a large black staphylinid or cock-tail beetle, that when cornered would turn at bay threateningly, raising its head and front up from the ground and arching its tail over its back; even snails —as the nursery rhyme reminds the more forgetful of us, with their sudden outthrustings of long horns, were a fearsome beast not to be approached without due caution.

All this time flowers and ferns and mosses were an equal fascination, and I don't think there was a day when I didn't bring home a handful of these treasures to be told their names: daisies and gowans, buttercups and dandelions, the tiny blue veronica of the hedgerow that we knew and loved as "bird's eyes," the little wild pansy or heart's ease, baby brother to the "Johnny-jump-ups" of our cottage gardens; then, as we went further afield, poppies and cornflowers, dogroses and sweetbrier, the primrose and the periwinkle, ragged-robin and cuckoo flower, wild thyme, eyebright, fox-gloves, bluebells and forget-me-nots. The very names make music in the memory; and it was just the names that we wanted to know. I don't think once heard they were ever forgotten. These names and images cling all through life and gather about them whole clusters of fond associations of time and space. In childhood, perhaps, they are little more than sense impressions, but as the spirit ripens into maturer years, they become informed with emotion, filling our imagination with fragrance and colour; such memories are good wholesome food for manhood's prime and the sweet solace of old age.

About this time my father's hobby of gardening seized hold of me; more, I suspect, for the gardener's sake than the garden's. One's father in those days was the strongest possible proof that giants if not gods still walked the earth in the semblance of men; and to help him water the garden was to be in paradise. I am afraid my help was little more than a hindrance, but I still see myself staggering along behind him with a watering pot; he was so absorbed in his work that the self-constituted under-gardener was often forgotten. I have sometimes since suspected this particular Olympian of being absent-minded.

He was a great smoker and nearly always had his pipe going; for use out of doors he carried a box of "fusees," a wonderful long-headed wooden match that

sputtered out a jet of fire capable of lighting pipes in wind or rain; the head was secured to the stick by wire-braid and retained its heat long after being thrown away, as I discovered on a certain memorable occasion when I tried to pick one up. It is told of my eldest sister that once as she toddled after my father in his majestic course down the garden path, one of these newly spent fusees thrown carelessly over his shoulder lodged on her neck and sizzled her into an agony of shrill screams that must have rudely dispelled the smoker's reverie.

My father was very fond of flowers, fonder still of shrubs—lilac, syringa, ribes, laburnum, laurel, cypress, golden yews and silver firs, but fondest of all of rhododendrons: "Roddy dandrums," so the mid Perthshire proverb flew, "Roddy dandrums are the minister's maggot"—All procurable varieties from white to wine-dark crimson flourished in the parsonage garden.

It stands out in my memory as clear as yesterday—so proud a day it must have been—how my father took me along with him one evening for a walk past some nursery gardens. Here he spotted a rhododendron a shade darker than any he had; finding the nurseryman out, he scribbled a note for him and returned with wheelbarrow and spade to the scene of the prize. The shrub was carefully dug up, mounted on the vehicle, and carted exultantly away, the very barrow calling aloud like a guinea fowl at every turn of the wheel; what a triumphal procession that was! I was still too small to help trundle the trophy home, but like the fly on the wheel I thought myself the hero of the day.

To grow these shrubs successfully, my father had cartloads of peat drawn from the neighboring loch of Ochtertyre, and every shrub was lowered into a great pit and filled in with well-pressed peat. One day, I remember, my father came in to lunch from the garden, and behold! the large silver watch was gone from his fob. Most of the afternoon was spent in undoing his morning's work, and it was only after three or four rhododendrons had been dug up and their peat-beds carefully sifted over that the watch was recovered. It still keeps good time, and has been an inmate of my waistcoat pocket for more than thirty years now.

Hitherto, I had been a rather solitary little mortal, but there now came into my life a close companion and bosom friend. This was a brother nearly two years older than I who came home at last from a prolonged visit to the south coast of England, as the rigors of our Scotch climate had been too much for him and he had been sent to the seaside in Sussex. He had stayed there so long that at first coming among us he seemed lost in an alien world and nothing could be found to comfort him. My panacea, to gather "wooden enemies" in the Beech Wood, did seem for the moment to brighten him up, but when he found the "wooden enemies" were only wind-flowers, and a walk to the Beech Wood led up hill through trees to a stone quarry instead of down over sand to the sea, his wrath and disappointment were greater than ever. After some weeks, however, he grew reconciled, and as he made friends very readily, he and I were soon as thick as thieves and always together. Our friendship was all the stronger that we were of somewhat different natures; like twin stars we helped to round each other's lives out to a fuller sphere of wider orbit. An aunt of my father's who stayed with us then, gave us nicknames that stuck for many a long day; she called me "Merry Andrew," and my brother "Slyboots." We were both of a height and could wear each other's clothes quite comfortably. As we were always dressed alike, there were very few outside the family circle who could tell us apart, and the less intimate half of our world supposed we were twins.

Certainly, not even the Siamese twins were more inseparable; we even slept together, in a little attic at the end of a long passage off the kitchen staircase.

Our partnership had not long been formed before we were sent to attend an institution in the town called "Morrison's Academy." Here we took an active part in the school games and made many friends and acquaintances. These were always boys who loved country life, and though none of them ever drew so close to David and Jonathan as to come between us, it often meant that three or even four of us would start out together for a holiday tramp.

Whenever I ponder over this community life of a boys' school, I am filled with wonder at the vast mass of tradition preserved in such a place. It offers a good illustration of the close analogy between children and savages; an immense lore is handed down unconsciously by bigger boys to the small fry from one generation to another. A great deal of this knowledge is forgotten by the individuals as they grow up, but it still survives in the schoolboy community. If as old men we could go back like Mr. Bultitude in "Vice Versa" to our school days we should be reminded of a thousand facts and fancies, primitive beliefs and superstitions, that the young barbarians of to-day have inherited by unbroken tradition from us boys of fifty years ago.

Local names (and even book names) for flowers and insects of wayside and wood, for beasts of the field and fowls of the air; original remarks, shrewd observations and quaint reasonings about their appearance, their habits, their haunts; all these form a common stock of ideas, food for conversation and thought as well as a basis for action, among hundreds of school boys more or less guiltless of the three R's of Reading, Riting and 'Rithmetic.

"Slyboots" and I fell heirs at an early age to a collection of birds' eggs made by our elder brothers when they were at school at Glen Almond. This was quite an extensive collection, ranging in size from a swan's to a golden crested wren's (gold-crowned kinglet's); it represented not only most of our inland birds of Perthshire from game birds and birds of prey to the sparrows and warblers, but sea birds like guillemots, razorbills, herring-gulls, curlews, sea-mews and terns.

Largely through our big brothers' kind offices we soon learned to associate every egg with the name of the bird that laid it; then we made it our daily business to recognize every bird we saw in the countryside by its plumage, flight, song, habits and haunts; we even ferreted out, in the home of a companion, a large work in several volumes on Birds, British and Foreign; we used to pore over its pages, especially the colored illustrations, till we knew the appearance of many birds, even hawks, ducks, and seagulls, far beyond the ken of our county. (120 birds' names.)

We were very tender-hearted for boys, and largely eschewed the society of the rough and tumble urchins who robbed birds' nests. A golden rule impressed on us almost from infancy was never to take more than one or two eggs at most from a nest, and always to leave at least half the clutch, or the birds would desert; indeed, we rarely took eggs at all, if we had any others of the same kind already. My recollection of the neighborhood is that, among the grown-ups at least, bird life was greatly respected. I well remember once with what a thrill of dread it struck me while bending over a "mossie cheeper's" nest by the roadside, to hear a cottager call out as she passed "Eh, laddie, ye'll never thrive, harrying the birds' nests!"

It was certainly a good thing that we had only one collection between us and seldom went in company on these excursions. For with the crowd there

was a regular code of law—an immemorial custom: as soon as a nest was spied, "Bags I first!" came the cry, "second!" "third!" and so on; here, bird's nesting was a ruthless pursuit, hardly an egg could escape, and the boys' sharp eyes went everywhere. My brother and I jogged along a much more innocent way, drinking in beauty and pleasure at every turn, and fostering a love of nature that has never left us. That we really were more innocent must have been obvious to the gang of nest-harriers and bird-killers, the bigger boys of the town, who despised us as simpletons and gulled us shamelessly in our chafferings and barters at school. As, for instance, on the flagrant occasion when I was persuaded that a lesser redpoll's egg of mine was only an undersized chaffinch's and agreed to dicker it for a cock's egg, which I was told was of very rare occurrence, as indeed it is.

Among the birds familiar even in childhood were three especially that filled us by their cry with a strange sense of mystery; one was the cuckoo whose influence on his boyhood Wordsworth has immortalized; another was the corn crake or landrail that called from the depths of the meadow grass below our attic window on warm June nights; and the third was the lapwing or crested plover. This last was known to our fraternity as the "peewit" or "peesweep." Like other shore birds, waders and runners (the sandpiper, for instance) this plover has a wonderful instinct for luring enemies away from its brood; when surprised near its nest, it will hobble and flutter and run just ahead of you, trailing a wing on the ground and holding out various signals of distress till it has coaxed you far from the danger zone; then up it soars with loud cries of triumph or derision; in the air it wheels round and round with calls of alarm; naturally, you hunt beneath this magic circle expecting to find the nest; but its circle is really an eccentric one, a sort of horizontal spiral whose centre is continually shifting; and it is safe to say that the nest is never under these movements of the bird, which are simply an ingenious form of camouflage or decoy. Like many of the birds that build little or no nest and breed gregariously, the plover often fails to hatch its young, and addled eggs are not infrequently met with.

I remember one day when my brother and I had found some of these plovers' eggs by going to and fro through a piece of bare pasture, we happened in with a gang of four or five bigger boys. They too had been hunting for peewits' eggs and had met with considerable success. They hailed us, and we drew together for a spell beside a cattle trough filled with water. One of the older boys asked us if we knew the way to tell fresh eggs from bad ones; on our replying in the negative, he showed us how, as he said, the fresh floated while the bad ones all sank; this was a wonderful discovery to us, and when he added to his kindness by exchanging our eggs that sank for some of his that floated we were overjoyed. As we turned to go, a wave of emotion seemed to overcome him—I suppose he was fairly nauseated with our innocence—he seized one of the freshest of the eggs (for it was floating high on the surface of the trough) and threw it full in my face. I was wearing, I remember, a new cricket cap of bright blue flannel; the shell of the bomb exploded on the peak of my cap and I was deluged with the contents of this miniature Chinese stink-pot and very badly gassed.

One memorable summer when I was eight or nine years old, we went to stay in Kent with some relatives in a large country house with extensive gardens and grounds. All kinds of wonders met us here, in the woods, hyacinths and wonderful

birds; magpies, jays, green woodpeckers, wrynecks, bottle-tits, goat-suckers; in-doors and out, tame things galore; rabbits and hares, rats, mice (white mice, field mice, dormice), doves, canaries, love-birds, toucans, and—most fascinating of all—silkworms.

Our cousins had trays and trays of these grey caterpillars fed with fresh leaves every day from the mulberry tree on the lawn. To watch these creatures feed and grow and moult, to see each one taken when it stopped feeding and put into a paper twirl or "poke"—a miniature cornucopia, to watch them spin their cocoon, and then to assist at the business of tearing away the rough outer scaffolding of yellow strands and fluff, pick out an end from the close-wound cocoon, set the cocoon in a glass of water and reel onto a skein-winder the whole interminable thread of golden silk, the cocoon bobbing about on the surface of the water in the glass, till finally the newly formed pupa sank through the last meshes of its hammock, and was put carefully away in dry bran for the moth to emerge: to see the moth lay its eggs, one after another, side by side, in batches on a sheet of paper spread over the bottom of the box, eggs that soon darkened from creamy color to leaden gray; all this was enchantment and we were soon bound fast under the spell. A whole room was devoted to the work, and its curtains and walls were hung with these inverted paper cones of spinning and pupating caterpillars.

The rage for silkworms travelled back to Perthshire that September on the Scotch express, to spread like influenza: not only did we send next spring to a London dealer in Natural History supplies, for some batches of eggs, but bit some of our particular friends with the mania, so that a silkworm cult was established in the Town of Crieff.

I am afraid the industry never throve; for one thing the mulberry does not grow in Scotland, and although lettuces make a fair substitute, the caterpillars are smaller and less hardy, so that quite a high mortality ensues between egg and adult. But we made, I remember, some interesting discoveries. In the first place, we devised quite an original form of incubator to coax the grub out of the egg a few weeks earlier than the natural season. We began by keeping the eggs on the kitchen mantelpiece just over a good fire that was always going; but presently, too impatient to wait, we tried putting some of the egg batches into the warm—almost—hot oven: the success of this experiment was almost too great, for the specks of grubs hurried out to feed before the lettuce got up from its bed in the garden to be fed on. It was at this time that we made our second discovery of dandelion leaves as a substitute for lettuce. The supreme result of keeping silkworms, however, was that it decided my brother and me to begin a collection of insects.

Several seasons earlier I had tried rearing some of my favorite woolly-bears, which I found feeding on dockleaves. This had been so far successful that I understood the connection of caterpillars with moths and butterflies, and the mystery of the chrysalis. And after my woolly-bears had been transformed to gorgeous tiger moths, I had gathered from the garden all the caterpillars I could find on cabbages, currant bushes and so on. But I must have been too young to collect systematically, for I don't think it ever occurred to me to keep the imago after its emergence. Two incidents of this earlier experience come back to me; one, how I watched a green caterpillar of the smaller white butterfly, when full grown, spin its little button and sling of silk and contract as though about to pupate. A day or two after when I looked for the chrysalis I found

to my amazement that a cluster of tiny yellow-silk cocoons had rent my larva in twain just about amidships. I took the box to my father and asked him, did caterpillars ever have young ones? The phenomenon was as big a puzzle to him, I remember, as to me, but he advised me to keep the brood under their glass lid and see what would happen. I don't think either of us was much wiser for seeing some small winged flies in the box a little later; I know I wasn't. The other incident was even more disappointing. In a lane near the town I found one day a strange chrysalis lying on the ground. It was certainly somewhat hard, but I suspected no guile, and, taking it home carefully, kept it for months in a box of bran; when at last I realized it wasn't going to hatch out, into some gorgeous new butterfly, "like the other chrysalises," I shed tears of disappointment. My chrysalis, in fact, was nothing more or less than a common date stone.

However, all this had been years before when I was quite little. Now I was nearly ten and had a partner almost two years older. Our collection grew apace in its first two seasons, and many notable accessions were made to it; among these, I remember, a large box of tropical butterflies bought at a bazaar; the pupa of a Death's Head Sphinx dug up in the potato garden; a magnificent green caterpillar with purple diagonal stripes on its sides and a horn on its tail found on a weeping willow at the end of the lawn; several rich velvety brown caterpillars of an Emperor moth taken feeding on heather up in the hills; and, superbest of all, our first Peacock butterfly.

This regal beauty is not found in Perthshire, but one of our next door neighbors, a boy five years my senior, had a fine collection of Lepidoptera and offered one of these gorgeous things as a prize to whichever of us could beat the other in a fight. Now David and Jonathan often fought in the heat of some momentary difference, but to be asked to stand up to one another in cold blood seemed a little too much; still, peradventure, for the sake of a Peacock butterfly! At last we managed to strike a bargain with the stony-hearted judge; whichever threw the other in a wrestling bout should have the butterfly, and we flew together before our chieftain in a close Scotch hug not unworthy of Donald Dinnie at the annual gathering of the Highland games in Strathearn. Whether "Slyboots" had figured it all out beforehand or not I shall never know, but I found it far easier to throw him in the wrestling bout than to pick up his friendship after the fall. The butterfly was mine, when we turned moodily away to go home; it was his ten minutes later when we entered the parsonage gate, deep in friendly converse and of joyful countenance.

If you think for one moment our little lives by now were full to bursting with all this hotch-potch of country fare in the few short months of a Highland summer, you've sadly forgotten the days of your youth. Children are much like dogs, they have a voracious appetite and they cover far more ground in the course of a day's journey than your sober-paced man; they haven't his steadiness of purpose and they hate to stay on the high road; but they're all eyes and ears and full of tireless energy, forever ranging over the surface of things, if never digging deep.

Between you and me and the gatepost, then, I haven't as yet so much as hinted at our really and truly favorite sport of the summer, a sport that at one time grew to a devouring passion and threatened to swallow up all its rivals. This Aaron's rod of our childhood was the rod that according to Dr. Johnson has a worm at one end and a fool at the other, but so long as the worm caught fish we didn't care a button what names you called the fisherman. As long,

almost as I can remember, a fishing trip was the greatest holiday treat we could think of. In my case, I am sure, there was never any danger of other interests getting crowded out; for I was never so absorbed in the gentle art that I didn't keep an eye open, to say nothing of my ears, for the rest of nature; everything living was fish to my net, and the contents of my wicker creel went far beyond the finny tribes. "Slyboots" caught more trout, but "Merry Andrew's" basket showed quite as big a catch; among other "queer fish," I brought home, I remember, a young rabbit, a sandpiper, two half grown wood pigeons ("cushie doos"), a bat, a swallow, an owl, a squirrel, a hedge-hog, and once, incredible as it may seem, a pair of full grown weasels. I had spied them playing together near the Forth, but when I hurried up with a collie dog that had made friends with me on the way, they took refuge in a drain-pipe; here I prodded them so with the butt of my rod that they rushed out to be mauled by the dog; whether I could ever have tamed them into pets, remains a moot point, for both died next day, and by the advice of a friend—an old naturalist—were laid out in the shrubbery as a bait for carrion beetles. As for the bat and the swallow, they had both flown at my fly-cast as it went sailing over my head and had actually been hooked in mid air. Many a strange adventure and many a rare sight met us on those fishing trips; once we actually had the luck to see a large otter with a sea-trout in its mouth. The older we got, the further we went; and the further we went, the longer grew our list of the wonders of creation.

Our earliest fishing trips took us to Ochtertyre after perch; the way to this loch led over fields past the corner of a small lake known as the Serpentine; here we caught our first dragon-flies and the little copper butterfly, gathered bullrushes and water-lilies, found our first nests of coots and waterhens, and were given once a swan's egg by one of the game-keepers. Later on, we found from a summer spent (with whooping cough) at the village of Gargunnock near Stirling, that we could catch brook trout; after that still-fishing for perch with a coloured float lost all its charm; even trolling for pike, and the novelty of hauling flounders and bream out of the tidal waters of the Forth paled before the fierce joy of climbing the trout stream, with its linns and grey mare's tails overhung with rowans and birch—the haunt of water-kelpies—up through the wooded glens to the wind-swept heathery moor where the lonely whaup goes crying among the mountain crags. Here with the spirit of solitude dwelt Mystery and Romance, and with beckoning fingers—all unknown but none the less imperiously—drew our boyish lives up to heights far above the welter of mundane things. And well for us both, that this Education of Nature had sped apace; for I was only just thirteen when a bolt from the blue brought the whole palace of delights tumbling about our ears with the sudden death of my father. By the time we had crawled painfully out of the ruins to build up the wreck of our happiness, we found ourselves living in a London suburb.

PRESENT DAY PROBLEMS IN ENTOMOLOGY.

J. J. DAVIS, WEST LAFAYETTE, ILL.

Cereals have always been our most necessary economic crop but the existing war conditions have greatly emphasized their importance and as you are all aware, insect pests are one of the chief causes of crop losses. Within the past year the United States Department of Agriculture has been able to increase crop acreages, especially that of wheat, by efficient publicity methods made possible through the co-operation of the State agricultural authorities and the County agricultural agents. This programme resulting in increased cereal acreages has brought about numerous changes in agricultural practices, such as rotations, an overbalancing due to the increased production of certain crops, and the introduction into certain localities of crops heretofore seldom if ever grown. These changes suggest new entomological possibilities which will become realities and more evident in later years.

At this time I wish to discuss briefly some of these conditions and to follow with a treatment of certain important cereal and forage crop insect enemies which are problems of the moment in the States of Iowa, Wisconsin, Illinois, Michigan, Indiana and Ohio, and which closely approximate conditions occurring in many parts of Canada, more especially in Southern Ontario.

As has been stated the effort for increased production of wheat, has resulted in the disregarding of certain rotations and an increase in the wheat acreage amounting, in Indiana, to 35 per cent. above normal or 50 per cent. above the 1916 crop, which may be considered a typical increase for the area under discussion. Without certain precautions this condition is almost sure to present advantages for the wheat insects, giving them unlimited breeding grounds under most favorable conditions. In some localities where the growing of spring wheat was discontinued a score of years ago on account of the continued ravages of insect enemies, the growing of spring wheat has again become common. It is not unlikely that if we must continue the growing of spring wheat in these areas we will again be confronted with the insect problems which brought about the change in cropping some 20 years ago. In fact, the Hessian fly has already made its appearance in threatening abundance in one locality where wheat was a crop of no consequence until the last year or so.

The problem of the cereal insect investigator differs greatly from problems confronting the entomologist dealing with orchard or garden pests, for the culture of cereals is less intensive and the expense of such practices as spraying is almost out of the question. We must rely almost entirely on general cultural methods although there are exceptions, notably the control of cutworms and grasshoppers by the use of poison baits. The present high prices for foodstuffs increase the possibility of using more intensive methods for controlling pests of general farm crops although here again we are limited because of the shortage of man power.

How we can most effectively assist the farmer to combat the many insect pests is itself a problem of huge proportions. In years past we have issued bulletins which were sent to persons interested or who requested specific information. Experience has taught us that the promiscuous mailing of such bulletins is a waste. At the present time a majority of the counties in the States have what is known as a county agricultural agent, a man who has made a success of farming or who has completed a course in an agricultural college or preferably

a man with both qualifications. Such a man cannot be familiar with all phases of farming and he is least likely to have a knowledge of the insect problems. It is evident that we must continue our detailed work and must publish our results, but it is equally evident since the conspicuous advent of the county agent that we should write publications which will appeal and be a help to him. The county agent is a busy man, having calls which keep him almost continuously in the field with little or no time for reading and he must therefore have ready references where he can secure the necessary information without having to read laboriously through pages of unnecessary matter. We have reference books which are well suited for this purpose, but these are usually out of date a few years after they have been published, and have in many instances resulted in recommendations for insect control which had been superseded by more efficient measures, discovered since the publication of the book. I have in mind a type of publication which should be more nearly what is needed to meet the county agent's requirements. Such a publication would discuss a certain class of insects, for instance, the more common corn insects, as a group rather than individual insects, and with it would be synoptic tables enabling the county agent to determine the trouble either from the type of injury or from the insect itself. These would be accompanied by typical illustrations of the insect and injuries. A table showing the seasonal appearance of the different insects would enable one to be on the lookout for certain pests. In such a bulletin the reading matter should be brief and concise and consist principally of methods of control and references to available publications where more detailed information could be obtained. To supplement such a bulletin the county agent should be provided with well illustrated leaflets treating of individual insects which could be handed to the farmer and these should contain just the points required by the farmer and nothing more. Since the advent of the county agent there has been a still further specialization in the form of extension entomologists, horticulturists, animal husbandmen, etc. Their duty is to keep closely in touch with the farmers through the county agents, to demonstrate their respective problems and in other ways to show the farmer by personal contact the better methods of farming. One might surmise that the advent of the State extension entomologist would preclude the need of publications for farmers. While this may to a certain extent limit the need of bulletins, on the other hand it may and does enlarge the value of the published data. For example, as recently given in a letter following a visit to help the farmers in a grasshopper stricken district, and as has been repeatedly stated to us, the farmers are pleased to know that such assistance is theirs for the asking and they become more receptive to bulletins and are more likely to make use of our published data.

I have briefly discussed how we may assist the farmer but we have another problem—how may we assist those who follow our recommendations but whose neighbors continue to disregard the proper methods of control and thus threaten the crops of those about them. Heretofore we have issued the necessary information by means of bulletins, institutes and demonstrations, hoping that farmers would adopt the practices. There are any number of instances, however, where the disregarding of recognized control measures by one has been the means of infesting a neighbor's crops. Two methods seem adaptable. One would consist in furnishing the farmer, from State or County funds, the necessary materials for combating insect outbreaks. Thus in Kansas, Prof. George A. Dean has found it practical for counties to furnish to farmers, poison bait for use in fighting grasshoppers. It seems that this is a step in the right direction for the farmer

seeing an impending outbreak, even though skeptical of the value of recommended control measures, will usually follow a practice if the materials are furnished free, or he may feel that since he will pay his share anyway in the form of taxes, he may as well get that which is coming to him. This method of procedure seems adaptable for fighting such insects as grasshoppers where the principal problem is procuring the materials but it does not answer the question of the wheat grower who wishes to protect his crop from Hessian fly by certain cultural practices. This brings us to the second method, namely, control by legal process. For years certain of the States have had laws requiring the spraying of orchards infested with San José Scale and other insects and nearly every State has a nursery inspection law requiring inspection of all nursery stock by competent inspectors, to prevent the spread of noxious insects. More recently, Dr. S. A. Forbes has advocated laws requiring a general use of all reasonable and practicable measures for the control of insect pests likely to spread from infested fields to the injury of the property of others, for, as Dr. Forbes has said, "Why should the farmer allow the chinch-bugs he has raised in his wheat to escape into his neighbor's corn any more than he should allow his cattle to break out of their pastures to feed on that neighbor's crops?"* Such a law is now in force in Illinois. The requirement of certain practices to safeguard the community by legal process is not uncommon in certain countries where it has proved an advantage and there seems to be no reason why the same requirements might not be an advantage in our own countries.

The conditions resulting from the war are giving the entomologist a greater opportunity to prove and illustrate the value of his work and are showing to him his shortcomings. With these changing conditions and especially with the coming of the county agent or district agricultural expert the duties of the economic entomologist are changing or, probably better, being advanced. The entomologist of the future must continue to investigate the problems dealing with the life histories of insects and to give practical demonstrations of the control measures and especially to standardize entomological practices. He must in addition delve deeper into the mysteries of insect life in its relation to physical and biological factors, especially meteorological influences and the changing field conditions due to varying crop rotations, more intensive farm practices, and the like. These will lead to another important phase of the future entomologist's activities, namely, the forecasting of insect outbreaks; in fact, we are already able and are making general forecasts of possible insect troubles, especially such insects as the Hessian fly, chinch bug, grasshopper, plant lice, and white grub. Our efforts thus far are quite primitive and not altogether certain but the speaker believes it will be a matter of but comparatively few years until the forecasting of the scarcity or abundance of this or that insect will be a routine, and an important routine, of the entomologist's office.

In a recent article† I had occasion to discuss the relation of entomology to allied agricultural subjects and attempted to point out the importance of co-ordinating our work with that of the agronomist, the horticulturist and others and the work of the entomologist of the near future, as I see it, makes this action not only desirable but imperative. To a like degree is it important for the student specializing in economic entomology to study entomology not as a subject by itself

*The insect, the farmer, the teacher, the citizen and the state. Illinois State Laboratory of Natural History, 1915, p. 12.

†Jour. Econ. Ent. Vol. 11, No. 5, Oct. 1918, p. 406.

as is now so commonly the rule, but in relation to other agricultural subjects; in other words he should use ecology in its broadest and practical sense, which is nothing more than relations between insects and the innumerable conditions affecting themselves and their hosts, and the economic application of these interrelations. The student, whether he is specializing in entomology or along general agricultural lines, should also be encouraged to read more of the general literature dealing directly or indirectly with insect problems. I have in mind one article which to me is a masterful essay, so scientifically accurate and yet so simply stated that it could not but impress the student. I refer to a paper entitled "The Insect, the Farmer, the Teacher, the Citizen, and the State," by Dr. S. A. Forbes. Other papers which I have in mind which should be read by every student in entomology which bear upon the problems discussed this evening are Dr. C. Gordon Hewitt's capable address before the American Association of Economic Entomologists on "Insect Behavior as a Factor in Applied Entomology"; Crosby and Leonard's paper suitably treating "The Farm Bureau as an Agency for Demonstrating the Control of Injurious Insects"; Forbes' address before the Entomological Society of America on "The Ecological Foundations of Applied Entomology," and the timely discussions, one by Cooley on "Economic Entomology in the Service of the Nation," a second by Felt on "Entomological Research and Utility" and the third by Forbes, "Entomology in Time of War." *

These few remarks are given that we may think more of and possibly foresee some of the problems which are to confront us as a consequence of the changing conditions partly resulting from the war, and to emphasize the importance of giving more consideration to our methods of publicity, and are not intended to suggest any specific methods or changes.

The insects of cereal and forage crops which have come to our attention the past few years and which are likely to continue troublesome are not numerous but are of immeasureable importance, and we will briefly discuss the different problems individually.

The Hessian Fly (*Mayetiola destructor*).

The Hessian fly, supposedly introduced into this country by the Hessian soldiers of Prussia, is, as Dr. Forbes has so truly put it, still a Hessian and is without doubt the greatest insect menace to wheat production in the United States. Especially at this time when wheat is so essential does this pest show up as one of the most important, if not the most important and most pro-German insect pest in the States. A year ago the Hessian fly was of little consequence, and again this fall it is not sufficiently abundant to cause undue anxiety but from past observations and the trend of conditions, and especially if we find the parasites

*Forbes, S. A. "The Insect, the Farmer, the Teacher, the Citizen and the State." Illinois State Laboratory of Natural History, 1915.

Hewitt, C. Gordon. "Insect Behavior as a Factor in Applied Entomology." Jour. Econ. Ent., Vol. 10, Feb., 1917, p. 81.

Crosby, C. R., and Leonard, M. D. "The Farm Bureau as an Agency for Demonstrating the Control of Injurious Insects." Jour. Econ. Ent., Vol. 10, Feb., 1917, p. 20.

Forbes, S. A. "The Ecological Foundations of Applied Entomology." Annals of Ent. Soc. America, Vol. 8, Mar., 1915, p. 1.

Cooley, R. A. "Economic Entomology in the Service of the Nation." Jour. Econ. Ent., Vol. 11, Feb., 1918, p. 16.

Felt, E. P. "Entomological Research and Utility." Scientific Monthly, Dec., 1917, p. 551.

Forbes, S. A. "Entomology in Time of War." Circular, Office of Illinois State Entomologist, 1917.

losing hold this fall as anticipated, it will only be a year or two before they are again an item of greatest importance to the wheat grower. The Bureau of Entomology, Division of Cereal and Forage Insects, under the direction of Mr. W. R. Walton, has instituted a series of stations in the principal wheat-growing areas of the United States where detailed studies are being made, in co-operation with the state authorities. Sowing experiments, where wheat is sown on different dates and variously handled, are in progress, in the district covered by the Lafayette Indiana Station, from Michigan to Tennessee. At Centralia, Illinois, in the centre of the southern Illinois wheat belt, we have a substation comprising 18 acres of land in charge of Mr. C. F. Turner and conducted in co-operation with Dr. S. A. Forbes. There intensive studies are made and much stress is laid on the effect of meteorological conditions. For obtaining meteorological data the several instruments giving records which may have a bearing on fly activities are utilized: thus we have in continuous operation not only the hygrothermograph, soil thermograph and rain gauge, but also the atmometer, an instrument which measures the combined effects of temperature, air currents and humidity, terrestrial radiation thermometers, anemometers, etc. This work has been in progress for two years and many valuable data have already been obtained.

The principal remedies advocated at the present time are sowing after the fly-free or safe date and destruction of infested stubble and subsequent volunteer wheat. Since one of these important recommendations is sowing after the so-called "fly-free" or "safe" date and since this date is necessarily not identical year after year, efforts have been made to determine a simple means whereby the county agricultural agent or a group of farmers can determine for their locality the safe sowing date each year. Thus various types of cages are being used to determine which are giving emergence records similar to natural conditions and checks are obtained by making daily records of Hessian fly caught on tanglefoot covered screens erected in the field and by daily egg counts made on specified plants. Sowing at the proper time is not alone a remedy and at most is not a preventive for spring infestation. To be 100 per cent. effective it must be accompanied by the destruction of wheat stubble wherever possible and the elimination of volunteer wheat. Our experiments show that plowing wheat stubble to a depth of 6 or 8 inches and subsequent harrowing destroys at least 92 per cent. of the flies but the practice of sowing clover in wheat makes it difficult to secure the universal practice of this measure and until the sowing of clover with other crops or by itself becomes more general we must continue to depend largely on sowing at the proper date to escape fly injury. Here again the value of proper sowing is dependent to a large extent on another factor, namely co-operation. If all of the farmers in the community do not follow the practice of sowing after the fly-free date, the one or more farmers disregarding the proper sowing date will furnish breeding grounds for the first brood of flies which may, if weather conditions are favorable, mature and infest the later sown wheat or at least the early sown crops will produce a generous supply of flies to infest the wheat in spring. Our laws do not make it possible for us to specify sowing dates and we must depend on the intelligence and honor of the community and much can be done towards securing the co-operation of a community by honor conditions. This is aptly illustrated by an occurrence which happened in southern Indiana a year or so ago when we were conducting a campaign in a particular locality to secure the co-operation of farmers to hold off sowing wheat until advised. One young man asked to learn the penalty if he promised to hold off sowing, but for some reason or other went

ahead and sowed before the proper time, and immediately an older man in the back of the room stood up and said "I guess there wont be any penalty but a heap sight of dishonor."

There are of course other considerations in the control of the Hessian fly such as the proper preparation of seed bed and use of fertilizers which enable plants to withstand injury, but it is not my intention here to go into details as I wish only to call your attention to the general subject of our problems. All of the methods of preventing or overcoming Hessian fly injury are what we might term good agricultural practices. Plowing under wheat stubble, except where it bears a good stand of clover, is good practice according to the agronomist, sowing after the fly-free date is, generally speaking, the best date to sow wheat regardless of insects, and the preparation of the seed bed and use of fertilizers are good agronomic practices pure and simple. Progress has been made with so-called fly resistant wheats and one or more of the wheats which are showing promising resistant qualities likewise rank above the average in yields.

Fig. 5.—Three year old apple orchard of 1,500 trees, completely defoliated by grasshoppers. Most of the orchard under cultivation and planted to navy beans which were destroyed previous to the orchard defoliation.

GRASSHOPPERS (*Melanoplus femur-rubrum* et spp.)

The past season we have experienced the most general and serious outbreak of grasshoppers for many years. Two years ago the grasshoppers were noticeably abundant in a few localities and in general the areas of grasshopper abundance were somewhat enlarged last year, while the past season they have appeared quite general and destructive in states where they have heretofore been of but comparatively little importance. There is every reason to believe that they will continue to be abundant next year, although probably not as severe as the past season.

As would be expected, the grasshoppers originated in fields such as timothy, blue grass and clover. The casual observer first noticed injury to clover towards cutting time when he found the plants completely defoliated, nothing remaining but the bare stalks and heads. The hoppers then left the clover for new fields, attacking such crops as were handy, as corn, soy beans, and navy beans; and not infrequently young orchards were defoliated. Thus at New Concord, Ohio, we

observed a three-year old apple orchard of 1,500 trees completely defoliated on August 17, and before the grasshoppers attacked the tree foliage they had cleaned up the navy beans which had been planted between the trees over most of the ground covered by the orchard. The insects even girdled the twigs in many places. At the same place we observed a bearing orchard with 20 per cent. of its ripening peaches destroyed, in some cases only the seed being left attached to the tree. It sometimes happens that the grasshoppers remain active until after wheat appears above ground in which case they may keep the wheat plants cut off close to the surface and as might be surmised, it requires but few of the insects to cut off the young tender wheat plants over a considerable area.

Excellent results in combatting grasshoppers have been obtained by the application of two standard remedies, namely, poison bait and the grasshopper catcher. As a general rule we have continued to recommend the standard poison bait formula of bran, molasses, fruits or lemon extract and a poison, preferably Paris green or crude arsenious oxide or white arsenic if neither of the first two mentioned are

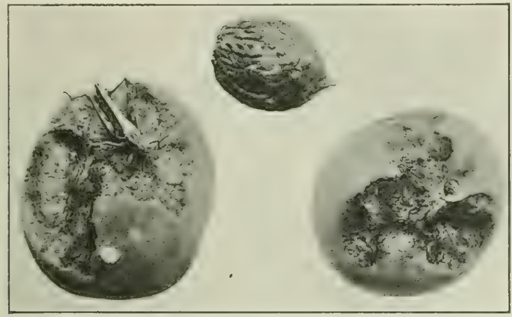

Fig. 6.—Ripening peaches damaged by grasshoppers. Sometimes only the seed remained attached to the tree.

available. However, the experiments of the past year, and especially the experiments conducted at Janesville, Wisconsin, by Mr. D. A. Ricker of the Lafayette Laboratory, indicate the non-essentialness of fruits or lemon extract when dealing with mature grasshoppers and that further studies based on age of the insect, meteorological conditions, et cetera, will show the need of important changes in the formula for grasshopper bait. Likewise a half and half mixture of hardwood sawdust, preferably that taken from an ice house, and bran has given results sufficient to warrant its recommendation. Indeed, Mr. E. E. Twing, county agricultural agent of Kalkaska County, Michigan, reports thorough success the past season in his county campaign against grasshoppers, using sawdust alone in place of bran in the poison bait. He used several tons of white arsenic for poison bait for practically all of which sawdust was used as the base. The crude arsenious oxide mentioned is a by-product of the copper smelters of the western states and is obtainable in barrel lots at 8 to 9 cents per pound; and in ordering, a powdered grade should be specified. It has given excellent results the past season wherever we have had an opportunity to observe its use and the results are practically equal to those obtained where Paris green was used. It was tested out in a grasshopper

infested section in Michigan, for example, where it gave such good results that the farmers of that section of the state, according to information furnished by Mr. Don B. Whelan, extension entomologist of Michigan, will order a car load in anticipation of grasshopper and cutworm troubles next year.

We find that the poison bait can best be used in fields such as clover about the time they are cut, by first cutting around the field leaving a small central area uncut in which the hoppers will congregate and here they can be slaughtered by the use of a comparatively small amount of poison bait. The bait is likewise of greater value in corn-fields, orchards, and amongst other crops where the grasshopper catcher cannot be used; and in corn fields it is advisable to make the bait more adhesive by an extra amount of water or, better, twice as much molasses, scattering the mixture forcibly amongst the crops so that small particles will adhere to the foilage.

The grasshopper catcher, such as was first recommended by Dr. E. D. Ball and later advocated by Cooley and others, proved highly successful wherever tried.

Fig. 7.—Field of navy beans being destroyed by grasshoppers entering from an adjoining field.

This catcher differs from the better known hopperdozer by having a screened box attached to the back (as illustrated), into which the grasshoppers are carried. This has a money value advantage over the hopperdozer in that the insects can be used as poultry feed. After filling the box it is a simple matter to haul the apparatus to the poultry yard where the grasshoppers can gradually escape through the front opening at a rate agreeable to a fair sized flock of chickens, thus giving us an ideal poultry self-feeder. Or, probably better, the insects can be bagged and allowed to die and dry within the bags and laid aside for winter use. Such feed for hens in winter appreciably increases egg production, not a small item these days. We have been able to secure an analysis of mature grasshoppers[1] through the kindness of Mr. E. G. Proulx, State Chemist of Indiana, with the following results.

[1]*Melanoplus femur-rubum.*

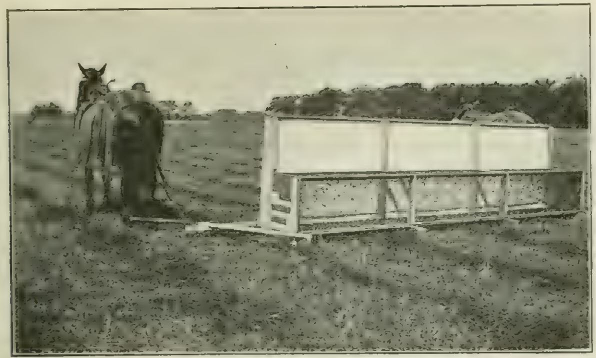

Fig 8.—Grasshopper catcher ready for action.

Analysis Based on Live Weight.

Moisture at 100°C with hydrogen	68.40%
Crude fat	1.94%
Crude protein	25.07%
Crude fibre	3.41%
Crude ash	1.24%
Total	100.06%

Calculation of Ash Constituents.

Nitrogen free extract	None
P_2O_5	0.59%
Na_2O	Trace
K_2O	Trace

On this basis dried grasshoppers would contain approximately 75 per cent. of protein.

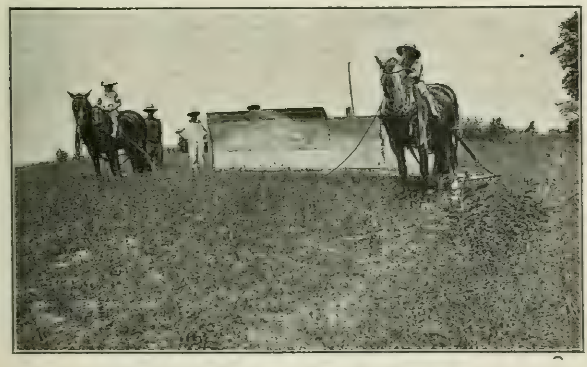

Fig. 9.—Grasshopper catcher in operation.

Our counts show an average of 500 live adult grasshoppers (*Melanoplus femur-rubrum*) to a pint and about 1,530 to a pound live weight or 4,500 to a pound dry weight. The cost of a grasshopper catcher is from $15 to $25, according to the amount of new materials which must be purchased, and usually it is possible to secure the tin, the largest individual item of cost, as second hand roofing. Considering that such a machine will last for many years, it is easy to see that the cost is repaid in poultry food in a comparatively short time, to say nothing of the value derived by eliminating the insects.

It is not possible to recommend one or the other of these two grasshopper control measures as the more valuable. In some instances, where for example large comparatively level acreages are to be covered and where labour is not scarce, the grasshopper catcher can be used to better advantage and more economically than the poison bait, while in other cases the opposite is true.

Cutworms (*Noctuidae*).

We can expect trouble from cutworms every year, and the past season has not been an exception to the rule. In many sections, more especially in Iowa and Wisconsin, they have been more severe than ordinarily, damaging principally corn and garden crops. The Feltias were most generally common, although in many localities the Euxoas were the principal depredators. In southern Indiana the bottoms of the Wabash river and tributary streams are subject to what are commonly termed overflow worms (*Agrotis ypsilon*). Some injury occurred the past season, but the insects were not nearly so general as the year before. They invariably appear following a late overflow, that is on land which is overflowed and covered with water as late as early June. As the water leaves the ground the moths make their appearance from the higher surrounding land and lay their eggs in the still wet soil: and any crop planted on this ground, which is usually corn, is likely to be damaged if not completely destroyed by the cutworms. It is unusual for a cutworm moth to lay its eggs in moist soil, but this appears to be the usual habit of this species (*Agrotis ypsilon*) and it has already been recorded as a serious pest in the areas overflowed by the Ganges and other rivers in India. Woodhouse and Fletcher * and other authors have given us very interesting accounts of the habits of this species as worked out in India.

You are all familiar with the methods of controlling cutworms. Aside from early fall plowing and certain rotations whereby ground likely to be infested is planted to crops not susceptible to cutworm injury, we have only one method of control, which fortunately is quite efficient. Our experience teaches us that poison baits such as are used against grasshoppers are equally effective against cutworms. In the case of the overflow worm it is also possible to escape injury if the ground is cultivated immediately after the water leaves the land and before the moths lay their eggs, but this practice is applicable only for small sections of individual farms, for it is not possible for the individual to cultivate a very large area before the moths appear and begin oviposition.

The So-called "Silk Bugs" (*Diabrotica 12-punctata* and *D. longicornis*.)

An insect, or rather two insects, which have ruined corn crops for many years in the overflow lands of the Ohio river in south-western Indiana but which have

*Woodhouse, E. J., and Fletcher, T. Bainbridge. "The Caterpillar Pest of the Mokameh Tal Lands." Agric. Jour., India, Vol. 8, pt. 4, Od., 1912, pp. 343-354.

been called to our attention only recently, are old and well-known reprobates more familiarly known to us as the southern corn root worm or bud worm (*Diabrotica 12-punctata*), and the northern corn root worm (*D. longicornis*). They are commonly pests of corn plants when in the larval stage, but as the "silk bug" it is the beetle that causes the damage and in an entirely different manner for it appears just as the ears are silking, cutting off the silk before the kernels become fertilized, thus causing the production of barren ears. One would expect the corn plant to be injured by the larvæ of these beetles earlier in its growth but such seems not to be the case, at least the corn shows no apparent injury. The probable reason for this is because the land is overflowed every winter and large amounts of rich humus are deposited, leaving the ground so rich that corn is planted year after year and the plants make such rapid growth that they overcome all injury to the root system inflicted by the larvæ of these two beetles.

We have no remedy for these pests under the conditions just given. As already

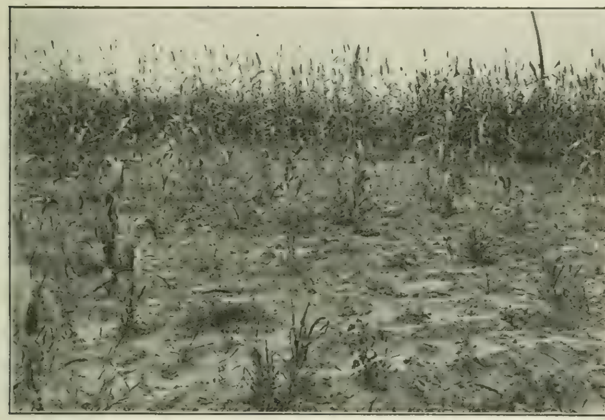

Fig. 10.—Field of cane damaged by White Grubs (*Lachnosterna* spp.)

stated the farmers prefer to grow corn on the ground year after year, giving the one species (*D. longicornis*) at least, ideal conditions for reproducing itself. Poisoning the beetle appears to be out of the question, but there is a likelihood of reaching them by the use of repellant dust sprays. More information on the life history and habits of the species under these conditions, new to us, is necessary before the problem can be intelligently attacked.

The White Grub (*Lachnosterna* spp).

Since the common white grubs have been serious pests in the northern states, this problem has been given considerable attention at the Lafayette Laboratory. The general results bearing on their economic relations have been published, and the natural enemies have been fully discussed in a paper soon to be issued. Many interesting data on their ecological and taxonomic relations have been, and

are continuing to be, accumulated through the co-operation of entomologists in Canada and the United States.

As might be expected for an insect having so widespread distribution and involving a life cycle of three years, the white grubs have several definite destructive broods. The important brood which occurs more or less continuously through the northern states from South Dakota to the Atlantic coast and in southern Ontario is present in the beetle stage every three years, 1917 being the last year the May-beetles were numerous. The year following the flight of beetles might be termed the "grub year" since the grubs are then in their most destructive stage. The important brood under discussion evidently began in an accumulative way some score of years ago. By 1909 and especially in 1912, they had become very abundant and destructive over a considerable area. In 1915 the grubs were again as abundant, or more so, as in 1912 but the damage was much less evident because the season was wet, which greatly assisted the corn and pastures to overcome some of the destructive work of the grubs. The past season (1918) grubs were again abundant, although less numerous than for several years past, but fortunately the conditions have been against the pests and comparatively small damage resulted. Parasites, predaceous enemies, and diseases have played a part in this result but certain climatic conditions are in a large measure responsible. In the spring of 1917 May-beetles were apparently as numerous in the soil as in any previous beetle year but the season was late and cold and the beetles came to trees in small numbers until quite late. Only a small percentage of the normal number of eggs were laid and most of these late in the season. As a consequence the grubs were abnormally small when cold weather set in, many of them too small to pass the winter successfully. This year the comparatively few grubs were small when the ground warmed up and they did not reach their destructive developmental stage until late in the year. From general observations it appears certain that the years of maximum abundance are passed and that we may expect fewer grubs of this particular brood for a number of years before conditions will again favor their enormous increase.

The principal methods of combatting white grubs are rotations and utilization of hogs and poultry. In white grub districts rotations should be arranged so that corn and other susceptible crops will not be planted on ground likely to contain grubs the year of their abundance, or better, the use of clover in the rotation, the clover to be followed by corn, since the beetles do not deposit many eggs in ground covered with a stand of clover during the May-beetle flight. The value of hogs to clear land of grubs has been repeatedly demonstrated. Other practices, such as fall plowing and the collection of May-beetles and grubs are only partially successful, but are good practices when supplemented by the measures already mentioned.

I have purposely discussed several of the more important insects of cereal and forage crops which have occupied our attention the past year or two. It is usual and to be expected that the economic entomologist spends much of his time with insects which appear in conspicuous numbers. There are however, hordes of insects of less importance which nevertheless are always present and which constitute a continuous drain on our crops but because of the inconspicuousness and gradualness of the losses they are not recognized seriously. Many of these inconspicuous insects are taking a heavy toll, and I believe we are coming to a time when they will be given their just consideration and it might be added, their just deserts.

Fig. 11.—Field of corn showing typical spotting of field caused by White Grubs (*Lachnosterna* spp.)

Fig. 12.—Trees defoliated by May-beetles (*Lachnosterna* spp.). The trees in centre are bur oak and the tree to right an elm.

Fig. 13.—Hickory woodlot defoliated by May-beetles (*Lachnosterna* spp.). The undefoliated tree to left is an apple.

INSECTS AS AGENTS IN THE DISSEMINATION OF PLANT DISEASES.

Lawson Caesar, O. A. C., Guelph.

The following was delivered as the President's Address:

There are three great classes of plant diseases in the dissemination of which insects play a part. These are:—first, diseases due to fungi; second, diseases due to bacteria; and third, diseases whose cause has not been discovered but which are of a decidedly communicable or infectious character. This last class is often called "Physiological Diseases," or "Diseases of Unknown Origin," the latter term being preferable.

Before discussing the rôle of insects as disseminators it may be well to give a list of the common agents in the spread of plant diseases. They are: wind, rain (especially wind-driven rain), infected seed, infected manure, infected soil, insects, slugs, man with his teams and implements, birds and a few other animals.

Of these various agents every plant pathologist would say that so far as the dissemination of spores of fungi is concerned, wind and rain are, with very few exceptions, such as perhaps Ergot of Rye, vastly more important agents than insects. In the case of diseases that have been introduced recently and that are not yet widely spread, insects may play an important part in long-distance distribution and in the establishment of new centres of infection, especially if the spores of such diseases are of the type that is held together by a gelatinous substance which prevents their distribution by wind alone, though after being dissolved in moisture they may be blown short distances by wind-driven rain.

In the dissemination of plant diseases insects may function in three ways. First, they may serve as mere carriers of the spores or other causal organisms from plant to plant. The amount of disease thus spread compared with that by other agents is probably small. Second, they may cause wounds of various kinds which afford ideal conditions for spores or bacteria to germinate in and establish new infections. This is of course a very important function because many kinds of spores and a large percentage of bacteria seem unable to enter plants in any other way than through wounds. Third, they may serve as direct inoculators, not only bringing the organism with them upon or within their body but actually inserting it, when feeding, into the tissues where it finds favorable conditions for development. This last is on the whole the most important of the three methods.

Insects as Disseminators of Fungus Diseases.

Sucking insects with a few exceptions, such as in the case of the spread of Ergot of Rye by flies and of Downy Mildew of Beans by bees, do not appear to play nearly so important a part in the spread of fungus diseases as do biting insects. This is probably because such sucking insects as feed upon plant tissues have minute, needle-like mandibles and maxillae and in feeding make very small wounds. These wounds do not expose the moist inner tissues or afford much better places for spore entrance and germination than do stomata and lenticels. Moreover, insects with such mouth-parts are not adapted for feeding upon spore masses and so seldom get their mouth-parts contaminated and act as direct inoculators of healthy plants. Biting insects are therefore much more important in the dissemination of fungus diseases of plants.

It is worth noting here that several species of Coleoptera and Orthoptera as well as some Lepidopterous larvae feed freely upon spore masses, and not only

become covered externally with the spores but pass many of them uninjured through their body in the excreta. When this is deposited on healthy leaves or on other parts of the plant it affords an additional source of possible infection, either through the spores germinating and working their way through the uninjured tissues or through their being washed by rains into wounds.

Examples of Fungus Diseases Disseminated by Insects.

Ergot of Rye (*Claviceps purpurea*). This disease of cereals and grasses is said by plant pathologists to be spread in the summer chiefly through insects, especially flies, which are attracted to the sweetish, somewhat milky fluid in which the conidia produced on diseased ovaries of florets float. As this fluid is sticky the flies become contaminated and carry the spores to healthy florets, thus setting up new infections.*

Downy Mildew of Lima Beans (*Phytophthora phaseoli*). Sturgis has shown that this disease is apparently largely distributed by bees. He found that the Mildew failed to appear to any appreciable extent until the flowers began to expand, but that it became well established by the time the blossoms had fallen. He also found that it began regularly in those inner parts of the flower which were touched by the bee when seeking nectar, thus strongly indicating that the bees were the carriers and inoculators.

Chestnut Blight (*Endothia parasitica*). This is a recently introduced disease and therefore its distribution to each new locality is much more important than would be the dissemination from tree to tree of some old, well established fungus. Studhalter, Ruggles, Metcalfe and others have studied the relation of insects to the Blight and have shown that while many insects distribute the spores it is chiefly those insects that cause wounds on the trees that are important as disseminators; because the disease can enter the tree only through wounds in the bark. Ruggles discovered that the Seventeen-year Cicada and a bast-miner were important agents and that the disease in many cases had entered through wounds made by them. The Cerambycid, *Leptostylus macula,* is important as a carrier and possibly also as an inoculator.

White Pine Blister Rust (*Cronartium ribicola*). This is, as everyone knows, another recently introduced disease, and it is not yet established in our northern pine forests. Its spores lend themselves to wind dissemination, but it is thought that insects play an important role in the spread of the disease. Only a few months ago Gravatt and Posey gave an account of their finding tiny Gipsy Moth larvæ feeding greedily upon the spore pustules of the disease on pine trees, and becoming almost yellow with the countless spores that adhered to the hairs of their body. It has been shown that these tiny larvæ can be carried even 20 miles by the wind, so that distant spread of spores of the disease by them would be expected. Gravatt and Posey examined wind-borne larvæ found on Ribes (the alternate host of the disease) and found aeciospores on them. They also found that leaves fed upon by the larvæ contracted the disease. There seems to be no doubt that such larvæ are in the New England States important agents in distributing the White Pine Blister Rust.

Gooseberry Twig Disease (Undetermined fungus). In Burlington I have seen a large, well-cared-for garden of gooseberries in which almost every plant

*Note.—Since writing the above I have been informed by Prof. Howitt that it has recently been demonstrated that wind plays a more important part in distribution of conidia of ergot of rye than was formerly believed possible.

had from one to ten or more twigs dead or dying. Diseased twigs were sent to Geneva and examined by J. G. Grossenbacher, who wrote that the trouble was due to an undetermined fungus which entered through openings made by a Cambium Miner, apparently *Opostega nonstrigella.*. The disease seemed to enter solely through these wounds.

SMALL CANKERS ON APPLES (*Leptosphaeria coniothyrium*). Parrott, Glover and Fulton in their study of Snowy Tree-crickets have shown how the cricket, *Oecanthus niveus*, is the agent in introducing the fungus that causes the small cankers around cricket egg punctures on apple trees. These cankers are found in Ontario as well as New York. This fungus, *Leptosphaeria coniothyrium*, is also the fungus that causes Raspberry Blight and is believed by the plant pathologists of Geneva to enter many raspberry canes through the wounds made by the egg punctures of the Tree-cricket, *Oecanthus nigricornis.*

HEART ROTS OF FOREST AND SHADE TREES (Several species of fungi). In almost every city may be seen maple trees with unsightly wounds, due to the burrows of the Maple Borer (*Plagionotus speciosus*). These wounds commonly allow the entrance of heart rots, which injure the wood and weaken the trees, often shortening its life. It seems reasonable to assume that similar diseases enter various forest trees, through injuries caused by Cerambycids, Buprestids or Ipids. It is true that most of these attack only sickly, dying or dead trees, but some attack healthy trees. Such gaping wounds as those caused in poplars and willows by the Snout Beetle (*Cryptorhynchus lapathi*) could scarcely fail to admit fungi. The evidence tends to show that this beetle is an important factor in the transmission of the European Poplar Canker (*Dothichiza populea*).

Referring to a species of Scolytus that attacks White Fir, Hopkins says " When the attack is not sufficient to kill the trees, these wounds heal over, but in the meantime a decay often sets in at these injured places, which extends through the heartwood and for several feet above and below the wound, thus rendering the wood worthless for lumber and often for fuel." In the same bulletin he says " It appears that insects contribute more to the spread of fungus of the bark and wood of the main trunk than do such diseases to the spread and ravages of insects."

BROWN ROT OF FRUITS (*Sclerotinia cinerea*). The spores of this disease are readily carried by the wind, but they usually fail to infect peaches and sour cherries in Ontario except through wounds or where fruits touch each other. Some varieties of plums and sweet cherries are very susceptible, even though their surfaces be unwounded. The joint investigations of the Bureaus of Entomology and Plant Pathology of the U. S. Department of Agriculture proved definitely the important part played by the Plum Curculio in the spread of this disease on peaches. Illingworth, Spencer and the writer in their studies of Cherry Fruit Flies found that sour cherries infested by the maggots of these flies were often conspicuously affected by Brown Rot and that where these insects were completely controlled very few cherries rotted even though they were left on the trees until overripe. Moreover, there is no doubt that placing maggoty cherries in baskets along with sound ones favours the development of rot, especially in warm weather; because even though the infected cherries be not rotten, they exude juice from the breathing holes made by the maggots and this gives ideal conditions for rot development.

Lack of space prevents our giving more examples of fungus diseases spread by insects, so we shall now pass on to the bacterial diseases.

Insects as Disseminators of Bacterial Diseases.

Compared with other agents insects play a much more important part in the spread of bacterial than of fungus diseases. This is partly because bacteria do not to any great extent lend themselves to dispersal by the wind, whereas wind is the chief means of fungus spore dispersal. Another reason is that during the growing season,—the time of greatest dissemination,—the bacteria in some plants are wholly concealed within the plants and are only obtained for fresh inoculations by penetration through the surface to them. This insects do. A third reason is that about half of our worst bacterial diseases can enter plants only through wounds and such wounds are made chiefly by insects. It is worth noting that though insects like Aphids or Capsids with very slender, piercing mouth-parts play but little part in the spread of fungus diseases they are often very important in the spread of bacterial diseases. This is because they feed indiscriminately on healthy and diseased portions of plants and thus by penetrating the diseased areas get their mouth parts contaminated; for no set of mandibles and maxillae are too small to carry numerous bacteria if once they reach them. Once the mouth-part is contaminated inoculation of healthy parts is easy. It looks, however, as if White Flies and Red Spiders were exceptions and did not play much part as spreaders. There are also cases like Cucumber Wilt in which it is doubtful whether Aphids can act as inoculators. Further study will doubtless explain such exceptions.

The fact that out of the eight common and important bacterial diseases of plants in Ontario three are disseminated almost exclusively by insects, shows the importance of insects in relation to bacterial diseases.

Examples of Bacterial Diseases Disseminated by Insects.

Cucumber Wilt (*Bacillus tracheiphilus*). It has been definitely proven that the Striped Cucumber Beetle (*Diabrotica vittata*), and to a less extent the 12-Spotted Cucumber Beetle (*Diabrotica 12-punctata*) are the chief and probably almost the sole distributors of this destructive disease and that if they could be exterminated the disease would almost disappear. It is very interesting to learn too that the disease is not only disseminated by these insects but is supposed to be carried over from one year to another by them and not through the soil.

Pear Blight (*Bacillus amylovorus*). This, as is well known, is a very destructive disease of pears, apples and quince, causing an enormous amount of damage some years and a considerable amount every year. It is nearly unanimously agreed that insects are the great factors in its dissemination both in the stage known as "blossom blight" and in the later twig blight stage. If a list were to be compiled of all the insects that had a part in the spread of this disease it would be a long one, for it includes many of the blossom frequenting insects, most sucking insects with piercing mouth-parts found on the apple and pear, and at least one bark beetle. In connection with this disease I may say that we have on several occasions found the gummy exudate at blossom time and have several times found ants feeding upon it. We also know that ants are common frequenters of the nectaries of blossoms. We consider ants therefore as the probable cause of the earliest cases of blossom infection.

Soft Rot of Vegetables (*Bacillus carotovorus*). This fairly common disease of cabbage, turnips, carrots, tomatoes, potatoes and celery is believed to enter solely through wounds, and insects and slugs are believed to be the main carriers of the organism as well as the chief inoculators. There has been a lot of

Soft Rot of Celery this year, for which the Tarnished Plant Bug is blamed. Efforts for control of the disease have been directed towards destroying this insect. The disease appears to winter over in the soil.

Bacterial Wilt of Crucifers (*Pseudomonas campestris*). Jones and others have shown that insects and slugs are important and common disseminators, though there are also other agents.

Other Bacterial Diseases. Very little is known as to the part played by insects in the spread of the other common bacterial diseases. Bean Bacteriosis (*Pseudomonas campestris*), Black Spot of Plums and Peaches (*Bacterium pruni*), Crown Gall (*Bacterium tumefaciens*) or Potato Wilt (*Bacillus solanisaprus*). We know, however, that the bacteria of the first two of these may enter directly through stomata without the aid of wounds.

Insects as Disseminators of Physiological Diseases or Diseases of Unknown Origin.

There are already many well known physiological diseases, and the list is being added to each year. A considerable proportion of our worst plant troubles come under this category. Insects do not play a part in the distribution of all, for instance they seem to have nothing to do with the spread of Peach Yellows and Little Peach. In many cases, however, insects appear to be either the sole agents in distribution or else very important agents. From the evidence available it would appear that most of the insects concerned are of the sucking and piercing types, though there seems no good reason why biting insects cannot also play a part. The infectious principle or virus seems in most cases and probably in all to be taken into the body of the insect and inoculation occurs through feeding.

Examples of Physiological Diseases or Disease of Unknown Origin Disseminated by Insects.

Mosaic Disease of Sweet Peas. Most growers of sweet peas are probably familiar with this easily recognized disease which weakens the plants and diminishes the size and beauty of the blossoms. Taubenhaus has shown that it is readily transmitted by aphids, but he says any biting or sucking insect may spread it. Most of the spread will naturally be due to aphids, because they are the most common sweet pea insects.

Mosaic Disease of Tobacco. This is a very important disease of Tobacco in the United States and may be identical with Mosaic Disease of Tomatoes, though probably not with Potato Mosaic. Allard has shown that the Peach Aphis (*Myzus persicae*), and also the Aphis (*Macrosiphum tabaci*), are very important spreaders of the disease. White Flies and Red Spiders he thinks do not distribute it.

Mosaic Disease of Cucumbers. This disease causes an annual loss of about \$1,000,000 in the United States. I have not seen it in Ontario but believe it has been found in a few localities. Doolittle and Jagger have proven that aphids are carriers and are probably the chief agents in its spread.

Curly Top of Sugar Beets. This disease occurs in the South-western States and some years is exceedingly destructive. The Beet Leaf-hopper (*Eutettix tenella*) has time after time been proven to be the distributing agent and so far as known the sole agent.

Spinach Blight. This blight attacks both spring and fall crops of spinach in Virginia, Ohio and parts of New York. Leaves of affected plants become

mottled and malformed and the plants finally die. The disease is a very important one and is said to be spreading. It was formerly thought to be due to malnutrition, but is now known to be a communicable disease, the virus of which is transmitted chiefly by the aphis (*Macrosiphum solanifolii*) but also to a lesser extent by another aphis (*Rhopalosiphum persicae*) and by the Tarnished Plant Bug (*Lygus pratensis*). The most interesting discovery in connection with this disease is that not only do aphids transmit it but also that their offspring down to the fourth generation can do so even though none of these offspring have fed upon diseased plants.

McClintock and Smith who made the above discovery think it very probable that aphids are also responsible for the tiding over in their own body of the disease from spring to fall.

In conclusion we may point out that the plan of controlling such diseases as are spread chiefly by insects by destroying the insects responsible, is in most cases impracticable; because some of the worst offenders, such as the Striped Cucumber Beetle, several species of aphids and the Tarnished Plant Bug, are among the most difficult of insects to combat successfully.

It is also worth while pointing out that it is only during the last few years that any careful study has been made of insects as agents in the dissemination of plant diseases, and that though some very brilliant work has been done, especially during the last four or five years, there still remains great scope for further careful investigation by entomologists and plant pathologists working together in close co-operation.

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THE CABBAGE ROOT MAGGOT (*CHORTOPHILA BRASSICAE*).

H. C. HUCKETT, O.A.C., GUELPH.

A study of the life-history and control of the Cabbage Maggot (*Chortophila brassicae*) was undertaken this year under Prof. Caesar's guidance. The study is still far from completion but some interesting results from different control methods have been obtained. The most important of these is, that on the whole corrosive sublimate has given better results than discs even where discs have been cleaned after each cultivation. Similar good results have been obtained with corrosive sublimate by the representatives of the Vegetable Branch, Department of Agriculture, Toronto: in fact they made the suggestion that led to our testing it.

Another interesting feature was that round discs, with a round hole in the centre and a slit leading to it, proved equally as effective as the hexagonal discs with the star-shaped centres and slit leading to this. Consequently in the tables both discs have been classed together.

Tests were also made with tobacco dust and lime and also with tobacco dust and sulphur. The results were promising, but much further work will be required to determine accurately their value and best method of using.

TABLE SHOWING RESULTS OF EXPERIMENTS IN CONTROL OF CABBAGE MAGGOT AT BURLINGTON

Method of Treatment.	Total No. of Plants.	No. Plants killed by damping off or accident.	No. Plants killed by maggots.	No. Plants that survived.	No. Plants dwarfed.	% living Plants.	% vigorous living Plants.	% killed by other causes than maggots.	% killed by maggots.
Corrosive sublimate....	652	55	13	584	20	89.6	86.5	8.4	2
Check	163	9	78	76	20	46.6	34.4	5.5	47.9
Discs, both round and 6-sided. Earth removed after cultivation...	504	71	31	402	15	79.8	76.8	14.1	6.1
Discs, both round and 6-sided. Earth not removed after cultivation	474	42	161	271	37	57.2	49.4	8.8	34.0
Check	326	50	127	149	31	45.8	36.2	15.3	38.9

TABLE SHOWING RESULTS OF EXPERIMENTS ON CABBAGE MAGGOT AT GUELPH, 1918

Method used.	No. plants.	No. dead from all causes.	No. alive.	No. dwarfed.	% alive.	% vigourous.
Corrosive sublimate	99	0	99	0	100	100
Tarred felt paper discs, round and hexagonal, kept clean............	101	0	101	0	100	100
Tarred felt paper discs, round and hexagonal, not cleaned............	97	7	90	6	92.8	86.6
Check	99	44	55	15	55.6	40.4

NOTE.—The better results obtained from the tarred felt paper discs at Guelph than at Burlington were apparently due to the plants at Burlington being set deeper in the soil and to the soil being sand, whereas the Guelph soil was clay. The greater amount of shade and the greater difficulty in keeping soil off the plants at Burlington gave the insects a better chance to cause injury. The corrosive sublimate in both cases was used at the strength of 1 part to 1,000 parts of water, or one ounce to 50 pints of water, and was applied with a watering can with a spout in which was inserted a small piece of wood to conduct the liquid directly to the roots without waste. Four applications were given in each case, the first, four days after the plants were set out and the remaining three at intervals of seven days. At each application sufficient liquid was used to wet thoroughly the roots. At Guelph more than was necessary was applied and at first a slight yellowing of the plants occurred, but they soon outgrew this and became just as vigourous as any plants in the plot. At Burlington no yellowing was observed and the plants were very vigourous throughout.

Corrosive sublimate has shown itself to be a very valuable substance in combating this pest, but a great deal of work is yet necessary to determine the best strengths to use, the number of applications necessary, and the best time to make each of these. Tests will also have to be made to determine whether this substance can safely be used with radishes and if so in what way. There is very little doubt that the growers would much more readily use corrosive sublimate than apply the tarred felt paper discs. They seem to have a decided objection to using the latter, though they have been recommended for so many years.

PROF. JONES: In the treatment of cabbage plants for Root Maggot was there any difference observed in the fertility of the soil to which corrosive sublimate had been added as compared with that to which it was not added?

MR. HUCKETT: No observable difference.

PROF. JONES: Corrosive sublimate is one of the strongest of our disinfectants, and in addition to destroying the egg or the larva of the Cabbage Maggot it would have a marked influence on the bacterial content of the soil. It would destroy the nitrogen fixer and the nitrifiers and also the decomposing species of bacteria; and providing there was not plenty of available food material in the soil ready for the plants to use, then on account of the corrosive sublimate I should imagine that synthetic action of the bacteria in the soil as well as decomposition action would be materially interfered with. That would depend upon how long the mercuric chloride was active in the soil after it had killed the maggots. Of course

the corrosive sublimate would become inactive within a reasonably short period, its poisonous action being neutralized by its affinity for proteid substances present in the soil, but to what extent its action would interfere with the fertility of the soil I think leaves room for some experimental worker to demonstrate.

SOME CHAPTERS OF THE EARLY HISTORY OF ENTOMOLOGY.

W. Lochhead, Macdonald College, Quebec.

The Beginnings of Entomology.

The beginnings of all sciences are full of interest as they reveal the gropings of earnest seekers after truth. Every natural science has an early stage when the knowledge of nature was extremely limited and clouded with superstition. It has been said that, "All knowledge begins and ends with wonder, but the first wonder is the child of ignorance"; but while wonder and curiosity have been great impulses to the study of that great mysterious world of nature, much of the knowledge of nature has come as the direct result of the experiences of early man in gaining his livelihood. Consequently we must look for the beginnings of Entomology in the practical lore of the hunter, the shepherd and the gardener long before the facts had been collated by the early naturalists.

A few references to insects are made in early writings, locusts, bees and ants being often mentioned by the old Hebrew writers (Exodus 8, Judge 14.14, Proverbs 6, Proverbs 30, Joel 1.4, Joel 2.25, Joel 2.2-10.) and scarabæid beetles sculptured in stone by the old Egyptians. It is very probable that the peoples of some of the ancient civilizations possessed considerable knowledge of natural history, including insects.*

Bee-keeping was a favourite occupation in Palestine, Assyria, Babylon, Carthage, Egypt, Greece and Rome. The Egyptians had even floating apiaries. A hieroglyphic bee has been found sculptured on a Sarcophagus containing the mummy of Mykerinos, King of Lower Egypt, about 3,633 years B.C., no doubt emblematic of the relationship between the King and the people.

Silkworms were cultivated many thousand years ago by the Chinese and the people of India, and the silkworm industry was an agricultural one.

We find also that the Egyptians had a high grade treatise on medicine 1500 years B.C., which must have been based on centuries of observation and practice, and also upon a knowledge of related sciences. However, whatever may have been the accomplishments of these people, no records have been preserved. To the Greeks, therefore, belong the credit of producing the first scientific treatise on natural history.

The first entomologist of whom we have any record was Aristotle (384-322 B.C.) Parts of three of his zoological works viz., *Historia Animalium*, *De Partibus Animalium*, and *De Generatione Animalium*, have been handed down to us. These reveal the many sided nature of his activities, for he was not only a collector and

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*When we reflect that practically all our cultivated plants and domesticated animals are of pre-historic origin, we are obliged to believe that pre-historic man maintained for long ages a high civilization, when skill and labor not only transformed wild life into cultivated fruitfulness and domestic use, but also made progress in the knowledge of the creatures (including insects) that associated with the plants and animals. Recent researches go to show that such an agricultural civilization occupied the Mediterranean Basin from Portugal through Asia Minor and Persia to Korea. Pre-historic cultivation terraces in this district still show how extensive were the plantations in ancient times.

classifier, but also a morphologist and inductive philosopher. He studied the life histories of many insects, he made many dissections and resolved the organs into tissues. His classification of inects, although based largely on external features, remained unimproved for more than 2,000 years, and his generalizations contained the ideas of an evolution from the simplest to the highest organisms in nature.

Concerning his own work Aristotle says: "I found no basis prepared, no models to copy........mine is the first step, and therefore a small one, though worked out with much thought and hard labor. It must be looked at as a first step and judged with indulgence."

Although Aristotle believed in the spontaneous generation of certain insects and other animals that appeared in the processes of putrefaction, his views regarding the generation of the higher animals are expressed in the sentence, "All living creatures, whether they swim, or walk, or fly, and whether they come into the world in the form of an animal, or of an egg, they are engendered in the same way." In fact, Aristotle had very definite even modern views regarding embryology, for he had studied the forming chick in the shell. He might be termed an epigenist, for he believed that "the parts of the future organism do not pre-exist as such, but make their appearance in due order of succession."

It is interesting to note that the methods of Aristotle are those of modern scientific workers, viz., INVESTIGATION BY OBSERVATION AND EXPERIMENT. It required, however, more than 2,000 years for workers to realize the importance of his methods in the study of nature.

Regarding Aristotle's knowledge of insect development and structure it may be said that he knew that there were male and female insects, and that they reproduced sexually. He knew that drone bees develop without fertilization, but he called the "queen" the "king" of the hive. He thought that "nits" do not produce animals, that spiders bring forth live worms instead of eggs, and produce threads of their webs from the external part of their bodies, that caterpillars are produced from cabbages daily, and that many insects rise spontaneously from putrefaction. He believed, too, that all invertebrates were bloodless. He separated the crustacea from insects, and divided the insects into winged and wingless. His sub-divisions were also partly perfectly natural. He considered the larva a prematurely hatched embryo and the pupa as a second egg.

Professor Sundevall estimates that Aristotle indicated and described about 60 species of insects and arachnidans and about 24 species of crustacea and annelids.

Aristotle is said to have written a treatise on bees, but if so, no tráce of it has reached us. Columella, however, tells us that the Greeks were proficient bee-keepers. That the Romans practised apiculture is very evident for Virgil devotes the fourth book of the Georgics entirely to a discussion of bees, their habits, economy, and management. Following Aristotle, he calls the queen the king of the hive, and believed that bees originate from decomposing bodies of bullocks (See also Judges 15 for a similar belief).

The Greek poets occasionally refer to insects. For example, Xenarchos says: "Happy is the Cicada, since its wife has no voice."

While Aristotle's knowledge of insects was full of crudities and errors, it must be confessed that he did a large amount of valuable work that has stood the test of time.

After Aristotle, the study of natural history declined and no work appeared until that of Pliny the Elder (23-79 A.D.) the Roman general and historian. His voluminous writings on natural history have been well preserved but they contain nothing new. They are complications of the works of previous writers

and include much fable and fancy joined with fact. Pliny's system of classification of animals is inferior to that of Aristotle's, although he adopts the latter's in the case of insects.

After Pliny the study of natural history declined rapidly and no attention was given it for about 1,500 years. Not only during the Dark Ages following the fall of the Roman Empire, but during the Middle Ages the study of nature was thoroughly discouraged as "proceeding from a prying and impious curiosity." Observation and reason were overthrown by biblical and classical authority and mental activity assumed the form of metaphysical speculation.*

Happily, however, much information was handed down regarding Natural History during these dark centuries in the form of practical lore of the farmer and gardener to which I have already referred, so that when science again showed signs of revival the naturalists had a basis on which to work.

The Revival of Science.

For several centuries bold minds had revolted against the traditional adherence to authority, and in the 15th and 16th centuries, Galileo, Descartes, and Vesalius (1514-1564) working along different branches overthrew the old traditions, and the new movement for the revival of science was fairly launched.

Mention should here be made of some of the investigators of the new era on account of their influence on the pioneer entomologists. Vesalius, a Belgian, studied medicine in Paris and gave much attention to anatomy. His great work "De Humani Corporis Fabrica" is a classic and "created an epoch," as it "overthrew dependence on authority (Galen) and re-established the scientific method of ascertaining truth."

Harvey (1578-1667) was the pioneer physiologist, and his splendid researches on the Circulation of the Blood have earned him a place among the great pioneers of science who questioned and experimented with nature to find out her secrets. Like Aristotle, he considered the larva a prematurely hatched embryo, and the pupa a second egg (*De Generatione Animalium*).

The Great Insect Anatomists.

The impetus given to the study of anatomy by Vesalius produced in the 16th century a large number of workers like Wotton, Gesner, Aldrovandi, and Jonston, who have been called the "encyclopedists" on account of their voluminous writings on many topics.†

*This attitude was expressed by Redi about 1668, thus: "Because he's Aristotle, it implies that he must be believed, e'en though he lies."

A curious collection of manuscripts called the "Physiologus" or the "Bestiarius", and produced under theological guidance, formed the main source of information on natural history during these times. The accounts deal with biblical as well as mythical animals, such as the unicorn, dragon, basilisk, and phœnix. Many are represented as symbolical of religious beliefs, and moral reflections are interjected at frequent intervals. Locy says: "The Zoology of the Physiologus was of a much lower grade than any we know about among the ancients."

†Conrad Gesner (1516-1558), a Swiss, was an indefatigable collector, observer and writer. His papers on insects were published after his death by Thomas Moufet, about 1634. Gesner is justly considered as the restorer of natural history. Long lost treasures were again made known and a stimulus was given for further research.

Aldrovandi (1552-1605) described the natural history of insects at great length in seven books. He divided insects into land and water dwellers, and these were subdivided according to the structure of their wings and legs.

The writings of Gesner and Aldrovandi contain many ridiculously improbable statements gathered from ill-attested sources and repeated from the writings of Aristotle and Pliny.

In the 17th century two insect anatomists, Marcello Malpighi (1628-1694) of Italy, and John Swammerdam (1637-1680) of Holland, made large contributions to science. Malpighi's treatise on the *Silkworm*, published in 1669, has become a classic. It was a pioneer work in a new field. The author had the advantage to the new aid to vision, the microscope, which came into use at this time through the ingenuity of Hooke, Malpighi, Swammerdam and Leeuwenhoek. Miall says, "For the first time the dorsal vessel, the tracheal system, the tubular appendages of the stomach, the reproductive organs and the structural changes which accompany transformation were observed." Moreover, he observed and described the nervous system, the urinary tubules (Malpighian) and the silk-forming apparatus.

"This research," says Malpighi, "was extremely laborious and tedious on account of its novelty, as well as the minuteness, fragility and intricacy of the parts which required special manipulation; so that when I had toiled for many months at this incessant and fatiguing task, I was plagued next autumn with fevers and inflammation of the eyes. Nevertheless such was my delight in the work, so many unsuspected wonders of nature revealing themselves to me, that I cannot tell it in words."

Miall says: The last distinct glimpse we got of him is interesting. Dr. Tancred Robinson, writing to John Ray, from Geneva, April 18th, 1684 tells how he met Malpighi at Bologna. They talked of the origin of fossils, and Malpighi could not contain himself about Martin Lister's foolish hypothesis that fossils were sports of nature. "Just as I left Bononia," he continues, "I had a lamentable spectacle of Malpighi's house all in flames, occasioned by the negligence of his old wife. All his pictures, furniture, books, and manuscripts were burnt. I saw him in the very heat of the calamity, and methought I never beheld so much Christian patience and philosophy in any man before; for he comforted his wife, and condoled nothing but the loss of his papers, which are more lamented than the Alexandrian Library, or Bartholine's Bibliothese at Copenhagen."

Swammerdam's researches on the May-Fly and the Honey Bee entitle him to a high place among insect anatomists. He found by dissection that "the queen is the mother of the colony, the drones the males, and the working bees the neuters; but he did not find out that the neuters were only imperfect females" (Miall). Swammerdam's contributions were collected and published after his death by Boerhaave under the title of "Biblia Naturae." The folio edition is a volume of 410 pages of text and 53 plates of excellent drawings. Swammerdam was a more critical observer than Malpighi, as evidenced by his accurate and complete descriptions and anatomical work.

Boerhaave gives us a picture of Swammerdam at work which the reader does not soon forget. "His labors were superhuman. Through the day he observed incessantly, and at night he described and drew what he had seen. By six o'clock in the morning in summer he began to find enough light to enable him to trace the minutiae of natural objects. He was hard at work until noon, in full sunlight, and bareheaded, so as not to obstruct the light; and his head streamed with profuse sweat. His eyes, by reason of the blaze of light and microscopic toil, became so weakened that he could not observe minute objects in the afternoon, though the light was not less bright than in the morning, for his eyes were weary, and could no longer perceive readily" (Miall).

The title of Swammerdam's work is entitled as follows:—

THE BOOK OF NATURE;

OR, THE

HISTORY OF INSECTS:

Reduced to distinct CLASSES, confirmed by particular INSTANCES, Displayed in the Anatomical Analysis of many Species.

and

Illustrated with Copper-Plates

including

The Generation of the Frog, the History of the Ephemerus, the Changes of Flies, Butterflies and Beetles:

with the

Original Discovery of the Milk Vessels of the Cuttlefish, and many other curious Particulars

By John Swammerdam, M.D.

with

The Life of The Author, By Herman Boerhaave, M.D.

Translated from the Dutch and Latin Original Edition,

By Thomas Flloyd.

Revised and Improved by Notes from Réaumur and others,

By John Hill, M.D.

LONDON:

Printed for C. G. Seyfret, Bookseller, in Dean Street, Soho.

MDCCLVIII.

He studied the phenomena of metamorphosis, and showed that the butterfly is contained within the chrysalis, and that the organs of the latter are developed in the caterpillar. He emphasized the point that the various changes do not occur suddenly. He distinguished between metamorphosis and moulting. Moreover, he opposed the idea of spontaneous generation.

The 18th century produced Pierre Lyonnet (1707-1789) of Holland, who surpassed all his predecessors in minute dissection. His memoir on the Goat or Willow Moth, (*Cossus ligniperda*), published in 1750, will always remain a classic of insect anatomy. It contains 18 quarto plates with 137 figures, but the text

is mainly a description of the plates. One does not know whether to marvel more at the great patience and manual skill required to make out such detailed dissections, or at his wonderful drawings and plates.

Lyonnet's skill in dissection, however, surpassed his knowledge of anatomy. His great monograph "reveals the lack of insight of a trained anatomist" largely on account of the fact that he did not receive that careful preliminary training in anatomy that his two great predecessors, Malpighi and Swammerdam, received. His contributions to science are confined entirely to matters of anatomy. He showed clearly for the first time what are now known as "imaginal disks" or "histoblosts."

Coming to the 19th century, the names of four anatomists appear on the scroll of fame, viz.: Strauss-Dürckheim, Dufour, Newport and Leydig. The trend of research was gradually changing from a monographic study of a single form to a comparative study of insects, and these with other invertebrate forms, and finally to histological and embryological investigations.

Hercule Strauss-Dürckheim (1790-1865) of France, continued the work of Lyonnet and published in 1828 a most valuable monograph of the Anatomy of the Cockchafer, entitled, "Considérations Générales sur l'Anatomie Comparée des Animaux Articulés, aux quelles on a joint l'Anatomie Descriptive du Melolontha Vulgaris donnée comme example de l'Organization des Coleoptéres." It contained many finely lithographed plates of 109 sketches which compare very favorably with those of Lyonnet. The dissections, however, lack the marvelous details of Lyonnet's work, but his memoir has the merit of broadening the scope of anatomy and of making it comparative.

Leon Dufour, a Frenchman, published between 1831 and 1834 a large number of memoirs on the anatomy and metamorphoses of different families of insects, thus extending the work of Strauss-Dürckheim in the line of comparative anatomy.

Dufour merits attention also because the great Fabre got his inspiration for his life work on reading a volume of Dufour's that came by chance into his hand. It was "the electric impulse that decided his vocation."

Dufour was a disciple of Latreille, and practised as a country doctor. Perhaps his greatest contributions to entomology were along the line of bionomics. He lacked, however, the requisite patience of concentrating his attention for a long period upon a definite object, although he enriched science with a large number of important facts; he was to a large extent unable to interpret them. For example, Legros relates how Fabre had his curiosity aroused when reading Dufour's account of his finding a small metallic Buprestis in the nest of a Cerceris wasp; apparently dead but without any symptoms of decay. To Dufour the Buprestis was dead and he attempted an explanation of the phenomenon. Fabre decided to make observations for himself, and "to his great surprise he discovered how incomplete and insufficiently verified were the observations of the man who was at that time known as the Patriarch of Entomologists."

Newport was the first of the modern type of Entomologists, since he applied for the first time the facts of embryology to insect anatomy. In 1832-34 he published his researches on the modification of the nervous system during the larval, pupal, and adult stages.

Leydig (1821-1908) is thoroughly modern: he broadened the work of Newport by the introduction of histological methods. His great memoir, "The Structure of the Animal Body" was published in 1864.

Great Insect Ecologists

By the term "ecologist" is meant here a student of the habits and life histories of insects. Most of the men whose names have already been mentioned contributed very materially to our knowledge of insect habits, but these contributions were incidental to the study of anatomy.

Francesco Redi, the Florentine scholar, poet, physician and naturalist (1626-1697) did much to shatter the dogma of spontaneous generation which, as we have already seen, had been accepted as the doctrine of the Church, and the scientific world for nearly 2,000 years. Aristotle had accepted the theory to explain the origin of many of the "bloodless" or invertebrate animals, but had excepted the higher animals. Redi proved by experiment that if the flesh of a dead animal were protected carefully from intruding insects no grubs or insects developed in it.

He was not so successful in solving the problem of the generation of parasites and gall insects where he was forced to the conclusion, in spite of contrary convictions, that these insects arose spontaneously. The results of his researches were published in 1668 under the title of "Experiments on the Generatiòn of Insects." His translator says that "The title of the work gives little hint of its varied contents. It is a formal letter grown into a book showing the attitude of seventeenth-century Italians towards their surroundings, and affording a clear insight into their conception of nature. The opinions of priests, philosophers, and poets of the period on natural phenomena of perennial interest, and here set down with grave simplicity, enlivened by occasional humorous comment, and many elaborate quotations from the classics are inserted as proof or refutations of theories advanced."

Among the other interesting topics discussed by Redi are Cherry Fruit Flies, Sheep Bot Flies, and Biting Lice of Birds. Our President, I surmise, will be interested in his description and drawing of the Cherry Fruit Fly. His drawings of the Mallophaga are numerous and suggestive of much close observation. He tells us that he used a microscope furnished with three lenses and made in Rome, and that the drawings were made at his request, by F. Pizzichi.

To the student of the history of biology, the book is a milestone marking the beginning of a great epoch. It records the first, and therefore the most important, statement supported by experimental evidence of that great generalization named by Huxley the Theory of Biogenesis.

It will be noted that Germany lagged behind the other countries of Europe in the study of insects, producing only two writers of any merit. Roesel von Rosenhof (1705-1759), a miniature painter, published "Insecten-Belustigungen" which contains many observations on the habits and metamorphoses of insects. His colored figures and sketches are interesting even at the present time. Frisch, a school teacher, published a number of observations.

Charles Bonnet (1720-1793), acting on the suggestion of Réaumur, demonstrated the sexual reproduction of aphids, but it was Lyonnet who discovered that male aphids appeared towards the end of summer and fertilized the eggs that wintered over.

Francois Huber (1750-1831), the blind Swiss naturalist, has given us much interesting information regarding the habits and economy of the honey-bee. It is said that "out of simple curiosity having undertaken to verify certain experiments of Réaumur's he was so completely fascinated by the subject that it became the object of the rest of his life" (Legros). He made discoveries respecting the impregnation of the queen, the conversion of a worker-larva into a queen by the

workers, the origin and elaboration of wax, the nature of propolis, the manner of constructing the cells and combs, and the ventilation of the hives. These discoveries are all the more wonderful when we remember that during the first period of his investigation Huber employed a half-educated assistant to make the necessary observations and experiments. During the middle and later periods of his life his talented wife and his son Pierre acted as his assistants. The latter made contributions of his own on the habits of ants and bees.

One of the first writers to give more attention to general habits and life histories than to structure was Réaumur, (1683-1757). His "Histoire des Insectes" gave a great impetus to the development of the scientific method of research by observation and experiment, and is one of the great entomological classics. Réaumur did not possess the manual skill for dissection or drawing of Lyonnet, Malpighi of Swammerdam, and he had to employ artists to draw for him. He possessed, however, great patience in observation and displayed much ingenuity in his experiments. Besides, his pages show a charm of language which made his volumes popular and gave them a wide reading.

Baron Chas. De Geer (1720-1728) of Sweden, was an anatomist, physiologist, and systematist, and his great memoirs on the "History of Insects" (7 volumes) compare very favorably with those of Réaumur. "A pupil of Linnaeus and a great admirer of Réaumur, he combined the systematic regularity of the one with the experimental skill and patient observation of the other." His works have always been considered a storehouse of important facts, clear descriptions, and enlightened observations. They contain "descriptions of upwards of 1,500 insects, a general history of their manners and metamorphoses and carefully executed engravings filling 238 plates."

Like Réaumur, De Geer was born to wealth, and had immediate command of everything that could help him in his investigations. Compared with Réaumur he was more concise and precise in detailing facts and vastly more methodical. On the other hand he showed less skill in making and recording his observations and experiments.

Great Insect Systematists.

Aristotle, as I have already observed, may be considered the first systematist, and his classification remained practically unchanged until the 17th century, when John Ray (1628-1705) made many important advances, bridging, as it were, the Medievalist and the modern systems. Ray published systematic works on both plants and animals, but his chief contributions were to botany. "He was the first to define the use of the word "species" and to lay emphasis on anatomical characteristics as a basis of classification." In his *Methodus Insectorum* the Arachnida, Crustacea, Myriapoda and Annelida are grouped with the Hexapoda under Insecta.

According to Ray, all similar individuals which show constant characters from generation to generation, or which breed true, form a species.

Carl Linnaeus (1707-1778) was a compatriot of De Geer. He was essentially a systematist. Sachs says: "He might almost be said to have been a classifying, co-ordinating, and subordinating machine." It is hard for us to realize the immense service Linnaeus did for science by the introduction of some system of order among the multitude of living things.

Locy says: "The chief services of Linnaeus to natural science consisted of these three things: bringing into current use the binomial nomenclature, the

introduction of terse formulae for descriptions, and fixing attention upon species." The "Species Plantarum" published in 1753 and the tenth edition of the "Systema Naturae" in 1758 are essentially catalogues of the names of the plants and animals arranged in a methodical way. The terms, class, order, genus and species, were established in classification. With the adoption of the binominal methods, "certainty and precision were introduced into the art of description."

Linnaeus' classification of the Insecta is as follows:—

I.—Insects with four wings:	
1. The anterior ones horny.	1. Coleoptera.
2. The anterior ones half horny and half membraneous.	2. Hemiptera.
a. All covered with scales.	
3. The anterior and posterior membranous.	3. Lepidoptera.
b. All naked. The nervures	
* Recticulated.	4. Neuroptera.
** Ramose.	5. Hymenoptera.
II.—Insects with two wings:	6. Diptera.
III.—Insects without wings:	7. Aptera.
1. With six feet, louse, flea and some others.	
2. With more than six feet.	
a. Head connected with thorax (spiders, crabs, etc.).	
b. Head free (centipedes, wood-lice, etc.).	

His *Insecta* corresponds, therefore, to our modern Arthropoda.

De Geer's classification is:—

1.—Insects with wings:
- A.—Gymnoptera.
  1. Lepidoptera.
  2. Elingula (Ephemerae, etc.).
  3. Neuroptera (Libellulae, and other Linnean Neuroptera).
  4. Hymenoptera.
  5. Siphonata (Aphides and Cicada).
- B.—Vaginata.
  6. Dermaptera (bugs and water bugs).
  7. Hemiptera (cockroaches and grasshoppers).
  8. Coleoptera (beetles).
- C.—Diptera.
  9. Halterata (Linnaeus Diptera).
  10. Proboscidae (the genus Coccus).

II.—Insects without wings. Aptera:
- D.—Saltatoria.
  11. Suctoria (the genus Culex).
- E.—Gressoria.
  12. Aucenata (the general Lepisma, Podura, Termes, Pediculus, Recinus).
  13. Atrachelia (the spiders and crabs).
  14. Crustacea (the Isopoda, Amphipoda, and Myriapoda of Latreille).

Fabricius (1748-1808), a Dane, was born in Schleswig and became a Professor at Kiel. His classification, published in his "Systema Entomologiae" in 1775 followed along a new path, the orders being defined by differences in the mouth-parts. By his system insects far remote were grouped together. His method of using solitary characters did not make for natural grouping.

His classification is as follows:—

I.—Insects with Biting Mouths.

A.—Two pairs of mandibles.	
a. The lower ones having palpi.	
1. Free without covering.	1. Class. Eleutherata (beetles).
2. Covered.	2. " Ulonata (Orthoptera).
3. Connate with labium.	3. " Synistata (Neuroptera).
4. Distended, thin, coriaceous.	4. " Piegata (Hymenoptera).

5. Horny, strongly toothed, labium without palpi.	5. Class.	Odonata (Libellulae).
6. All without palpi.	6. "	Mitosata (Scolopendra).
B.—A pair of maxillae resembling scissors.	7. "	Unogata (scorpions and spiders).
C.—More than two pair of maxillae.		
1. Within the labium.	8. "	Polygonata (Isopoda).
2. Outside the lip closing the mouth.	9. "	Kleistognatha (short-tailed crabs).
3. Outside the lip but covered by the palpi.	10. "	Exochnata (long-tailed crabs).

II.—Insects with Suctorial Mouths.

1. In the mouth a spiral tongue.	11. Class.	Glossata (Lepidoptera).
2. In the mouth a horny proboscis, surrounded by jointed sheaths.	12. "	Rhyngota (Hemiptera).
3. In the mouths a soft unjointed proboscis.	13. "	Antiliata (Diptera).

Summarizing the results briefly one may say that Swammerdam based his classification on *metamorphosis,* Linnaeus on *wings, and* Fabricius on *mouth-parts.*

As already observed the classifications of Linnaeus, De Geer, and Fabricius were based chiefly upon superficial features and not upon deep fundamental characters. The systems were artificial, but convenient for purposes of identification. The natural system was not fully established for another seventy-five years, and was elaborated by Cuvier (1769-1832), Latreille, Lamarck, Leach, Kirby and Spence, Oken and Macleay. The division Aptera had long perplexed systematists. Cuvier proved clearly that the crabs, etc., could not be retained among insects, forming the class Crustacea for them.*

Lamarck removed the spiders, scorpions, etc., constituting the class Arachnida for them, including therein the mites, centipedes, springtails and lice. Latreille,** however, formed the class Myriapoda for the centipedes, the order Thysanura for the springtails and the order Parasita for the lice.

Latreille's ordinal classification is as follows:—

I.—Apiropoda. Condylopes with more than six legs.		
1. Class. Crustacea.		
2. " Arachnides.		
3. " Myriapoda.		
II.—Hexapoda. Condylopes with six legs.		
4. Class. Insecta.		
A.—Insects without wings.		
a. Without metamorphosis.		
* With mandibulate organs.	1. Order.	Thysanura.
** With suctorial mouths.	2. "	Parasita.
b. With perfect metamorphosis.	3. "	Siphonaptera.
B.—Insects with wings.		
a. Elytroptera. The anterior wing covers the posterior like a sheath.		
* Mandibulate mouth. Cases horny. Perfect metamorphosis	4. "	Coleoptera.
Cases horny, imperfect metamorphosis.	5 "	Dermaptera the genus.
Cases coriaceous. Imperfect metamorphosis.	6. "	Orthoptera.
** Suctorial mouth.	7. "	Hemiptera.
b. Gymnoptera. Wings alike.		
* Four wings.		

*It will be recalled that Aristotle separated the Crustacea from the insects as a separate class (Malacostraca).

**Leach first used the term Myriapoda for centipedes and millipedes.

† Mandibulate oral organs at least distinct mandibles.	
Wings with reticulated nervures.	8. Order. Neuroptera.
Wings with ramose nervures.	9. " Hymenoptera.
†† Suctorial mouth. Mandibles abortive.	10. " Lepidoptera.
** Two wings.	
† Two distorted moveable processes on the prothorax.	11. " Strepsiptera.
†† Poisers behind the wings.	12. " Diptera.

Kirby and Spence's Classification (*Introduction*) is as follows:—

I—Insects with mandibles. Mandibulata.
1. Order. Coleoptera (like Linnaeus and Latreille. Eleutherata, Fab.).
2. " Strepsiptera, Kirb. (Rhiphiptera, Latr.)
3. " Dermaptera, Leach (Family Forficula, Latr.).
4. " Orthoptera (like Latreille, but without Forficula).
5. " Neuroptera (like Linnaeus and Latreille, but without the Trichoptera).
6. " Hymenoptera (like Linnaeus and Latreille).

II.—Insects with suctorial mouths. Haustellata.
7. Order. Hemiptera (like Linnaeus and Latreille).
8. " Trichoptera (Leach).
9. " Lepidoptera (Linnaeus and Latreille).
10. " Diptera (like Linnaeus and Latreille).
11. " Aphaniptera, Kirby (Suctoria, Latr.).
12. " Aptera (all apterous insects breathing through tracheae).
* Hexapoda (Ametabola, Leach, Thysanura, Parasita Latr.).
** Octopoda (Arachnides, Tracheales, Latr.).
*** Polypoda (Myriapoda, Leach, Latr.).

We will note that in the Aptera are included the hexapod spring-tails and lice, the octopod mites, and the polypod centipedes.

McLeay's Classification (*Horae Entomologicae,* 1821) is as follows:—

ANNULOSA:
1. *Crustacea* (according to Latreille).
2. *Arachnida* (according to Latreille).
3. *Ametabola* (Myriapoda, Thysanura, Parasita of Latreille).
4. *Haustellata.*
5. *Mandibulata.*

Ptilota.

Mandibulata	Haustellata.
Larvae with feet, pupae obtectae.	
Trichoptera (Semblodes, Phryganea, etc.)	*Lepidoptera*
Larvae apods, pupae exaratae.	
Hymenoptera	*Diptera*
Larvae varying, pupae free and quiet	
Coleoptera	*Aptera* (Suctoria, Latr.).
Metamorphosis semi-complete, Larvae resembling the imago.	
Orthoptera	*Hemiptera* (Hemip. Heteroptera, Lat.).
Larvae with six feet, metamorphosis varying.	
Neuroptera	*Homoptera* (Hemip. Homopt. Latr.).

THE STUDY OF PARASITISM AND NATURAL METHOD OF CONTROL.

From early times students of insect life have observed that sometimes from caterpillars and their chrysalids there emerge insects that are different from them and that often cause their death. According to Silvestri, Aldrovandi (1602) was the first to observe the exit to the larvæ of *Apanteles glomeratus*, which he thought were eggs, from the common cabbage caterpillar. Later, Redi (1668) recorded the same observation, and others on insects of different species.

Valisnieri (1661-1730) was probably the first to discover the real nature of

parasitism. About the nature and work of these parasites he wrote, "If sometimes there are born, (from one insect different ones) they are what I should call false individuals, being born from a different kind of worms which have been deposited there by their mothers, so that they may feed off the real native worm. This is a law ordained in this base world by the Supreme Creator which I have not yet well understood, that the larger always devours the smaller, and is its tyrant, a law which I have constantly observed in all forms of life, winged, four-footed, and aquatic."

Cestoni, a contemporary of Valisnieri, in a letter to him speaks at length about the parasites of *Aphis brassicae, Pieris brassicae,* and finally of Aleyrodes *brassicae.* He calls the insects of this latter species first "butterfly atoms" and then "little cabbage sheep" and their parasites, "wolf-mosquito."

Réaumur, about 1735, and De Geer about 1760, published records of many parasitic forms. About the beginning of the 19th century considerable attention was given to the study of insect parasites by several Zoologists, and many records were published. Ratzeburg's great work on "The Ichneumons of Forest Insects," published about 1850, was for a long time the great classic on the subject. During the last part of the 19th century entomologists of many countries made important contributions so that by the end of the century the literature on the subject was quite voluminous.

Professor Trotter tells us that the first person to divine the importance of parasitism and to apply the principle successfully was Boisgiraud of Poictiers in France. About 1840 he freed the poplars in the suburbs of his town of Gypsy Moth by placing there *Calosoma sycophanta*, and he destroyed forficulids in his own garden by using *Staphylinus oleus.*

These successes seem to have inspired the Milanese in 1843 to offer a medal to be given in 1845 to any person who had in the meantime conducted successful experiments in the artificial breeding of carnivorous insects which may be used advantageously to destroy insects injurious to agriculture. To this appeal Antonio Villa responded in 1844 by a pamphlet entitled: "Carnivorous Insects used to destroy Species Injurious to Agriculture," in which are set forth at length the results of successful experiments carried on by him at Desio in the Province of Milan. In these experiments Carabids and Staphylinids were used. Villa's results were criticized by Bassi, Bellani, and Ratzeburg. The latter said that "Carnivorous insects can be applied to the needs of agriculture only by the beneficent hand of nature and that every effort to assist it must be in vain."

Rondani, a few years later in the sixties, made important studies of insect parasites, chiefly dipterous and hymenoperous forms. In his "Account of Parasitic Insects and their Victims" he shows the importance of these insects in agriculture, and gives a table of parasites known as enemies of injurious insects.

In France, Perris and Decaux carried on valuable experimental work with parasites and predaceous insects in the early seventies.

From that time the U.S. have taken the lead, **not only in** the study of parasitism but also in economic entomology.

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THE PEAR PSYLLA IN ONTARIO.

W. A. Ross, Dominion Entomological Laboratory, Vineland Station.

The following paper is based largely on insectary and orchard investigations which were conducted at the Dominion Entomological Laboratory at Vineland Station, Ontario, in 1917 and 1918. In the insectary the psylla was bred on pear seedlings grown in flower pots and covered with lantern chimneys.

History and Distribution.

It is believed that the pear psylla (*Psylla pyricola*) was first introduced into North America in 1832 on pear trees imported into Connecticut from Europe. According to Slingerland and Crosby,* the insect is now generally distributed over the Eastern United States as far south as Virginia, and it also occurs in California.

It was first discovered in Canada in 1894 at Freeman, Ont., at which place it was found seriously injuring a block of three hundred Dwarf Duchess pear trees. Since then it has been recorded from other parts of Ontario, from Nova Scotia, and from British Columbia. Professor Lochhead informs me it has never been taken in Quebec.

In British Columbia, according to Mr. R. C. Treherne of the Dominion Entomological Branch, the psylla is present only in the lower Kootenay country where it was first observed in the spring of 1917. As the B.C. form occurs only on apple and as it differs slightly from its Eastern fellow, there is room for doubt, in my mind at least, as to its being *P. pyricola.*

Professor W. H. Brittain, Provincial Entomologist for Nova Scotia, informs me that in that province the pear psylla is injurious in some years and in other years it is very little in evidence.

In Ontario the insect has been taken in the counties bordering Lake Erie and Lake Ontario as far East as Trenton. However, outside of the Niagara and Burlington districts (where it is only too frequently very destructive), it is of comparatively little importance.

Our observations indicate that, in this province at least, the psylla is primarily a pest of the large orchard or of sheltered orchards. For reasons at present not clear to us, conditions in small plantings do not seem to be favorable for its rapid multiplication and in such places it seldom attains destructive proportions.

*Manual of Fruit Insects.

Nature of Injury.

The psylla causes injury by extracting with its sucking mouth-parts the sap from the leaves, leaf petioles, fruit stems, and tender wood on which it feeds. On badly infested trees, the continual sapping of the life juices by myriads of insects robs the tree of vitality, dwarfs the fruit, produces brown, dead areas on the leaves (Fig. 14) and, in extreme cases, causes the foliage to drop prematurely. Trees seriously weakened by this pest are especially susceptible to winter injury and in a hard winter like that of 1917-18 readily succumb to low temperatures.

Large quantities of a sweet sticky liquid called honey-dew are excreted by the psyllas, and on attacked trees the foliage, fruit, twigs and branches may be covered with this sticky material and with a sooty fungus which grows in it. (Fig. 15). This coating of honeydew and sooty fungus not only makes the trees and fruit very unsightly but it is very probable that it is also detrimental to the physiological functions of the leaves.

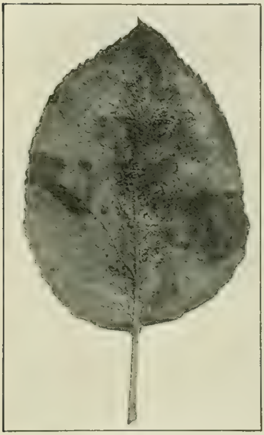

Fig. 14.—Leaf injury caused by pear psylla.

Fig. 15.—Leaves showing honey-dew fungus and nymphs.

Life History.

Summary.

The winter is passed in the adult stage. The adults hibernate under the rough bark on the trunks and main limbs, and under grass, leaves and rubbish near the infested pear trees. In late March or early April the insects leave their winter quarters, congregate on the twigs and fruit spurs and in a short time, provided the weather remains propitious, commence to lay eggs. Oviposition may continue until about the time the petals drop; however, the vast majority of the eggs are laid by the time the fruit buds have burst. The eggs are deposited on the twigs, fruit spurs and smaller branches, chiefly on the under surface. They commence to hatch when the fruit buds are beginning to break, and nearly all have hatched

by the time the petals drop. The period of incubation varies, according to the temperature, from 8 to 32 days, the average being about three weeks. The newly hatched nymphs migrate to the opening buds where they feed chiefly on the petioles and blossom stems. They grow rapidly and after moulting five times reach the adult stage in about one month. This first brood is then succeeded by three other broods, and the life cycle is finally completed in the fall by the appearance of the winter adults—the hibernating forms.

The Egg.

Description: The egg (Fig. 18) is sub-oval, blunt at the base and pointed at the apex. In colour it is creamy or pale yellowish with orange at the base. In length it varies from .315 mm. to .340 mm.

The egg is attached to leaf or bark by a short stalk projecting from near the basal end, and at the apex there is a long hair-like filament.

Fig. 16.—Showing eggs along midrib of leaf. (Much enlarged.)

Fig. 17.—First generation eggs laid on bark. (Much enlarged.)

Location of Eggs: The overwintering females deposit their eggs on the twigs, fruit spurs and smaller branches, chiefly on the under surface. (Fig. 16). After the buds have burst, belated females may be found laying their eggs on the young leaves.

The eggs of the summer forms are laid principally on the leaves, singly or in clusters, along the midrib (Fig. 17). They also may be found on the leaf petioles and shoots.

Period of Incubation: In the case of first generation eggs, i.e., eggs laid by overwintering females, the period of incubation was determined in 1917 from a study of 21 batches of eggs deposited at various dates from April 14th to June 9th. The average period was about 20 days, the maximum and minimum being respectively 32 and 8 days. The average duration of the egg stage in April was 26 days, in May 19 days, and in early June 11 days. (See Table No. 1).

TABLE No. 1.

Year.	Duration of Incubation of 1st Generation Eggs.				
	Date of Deposition.	Number of Lots.	Maximum Duration.	Minimum Duration.	Average Duration.
			Days	Days	Days
1917....................	April 14–22...	8	32	23	26
1917....................	May 2–29.....	9	28	11	19
1917....................	June 3–9......	4	13	8	11

In experiments with 40 lots of 2nd, 3rd and 4th generation eggs, the average duration of the egg stage proved to be 11½ days in June, 7½ days in July, 10 days in August, and 12½ days in September. (See Table No. 2).

TABLE No. 2.

Year.	Duration of Incubation of 2nd, 3rd and 4th Generation Eggs.					
	Date of Deposition.	Generation.	Number of Lots.	Maximum Duration.	Minimum Duration.	Average Duration.
				Days	Days.	Days
1917.............	June 19–29..	2nd	5	15	8	11
1918.............	June 8–12..	2nd	3	14	10	12
Average	June 8–29..	2nd	8	15	8	11½
1917.............	July 3–31..	2nd, 3rd	10	12	4	7
1918.............	July 9–26..	2nd, 3rd	5	10	6	8
Average	July 3–31..	2nd, 3rd	15	12	4	7½
1917.............	Aug. 3–27..	2nd, 3rd	10	15	6	10
1918.............	Aug. 15–26..	3rd, 4th	3	11	9	10
Average	Aug. 3–27..	2nd, 3rd, 4th	13	15	6	10
1917.............	Sept. 5.....	3rd	1	14	12	13
1918.............	Sept. 1–17..	4th	3	23	6	12
Average	Sept. 1–17..	3rd, 4th	4	23	6	12½

THE NYMPH.

Description: 1st instar. Oval and very flat in shape. Antennae translucent with dusky tips. Eyes reddish. Head pale yellow with a narrow median line of cream. Thorax pale yellow. Abdomen yellowish with lunule of deep orange. Legs translucent, dusky tarsi. Length .36 mm.

2nd instar. Similar to the 1st. Length .54 mm.

3rd instar. Similar to the 1st. Wing-pads apparent. Length .72 mm. to 8 mm.

4th instar. Similar to the 5th. Length .9 mm. to 1.08 mm.

5th instar. Oval and very flat in shape. Antennae light brown with dark brown tips. Eyes reddish. Head dark brown with a longitudinal median line of creamy grey. Thorax creamy grey blotched with red, with dark brown markings arranged as in illustration; wing-pads dark brown. Abdomen: anterior third creamy grey with three dark brown transverse bands interrupted in the middle, posterior two-thirds dark brown. Length 1.44 to 1.62 mm. (Fig. 18).

Habits: Upon hatching out in the spring, the nymphs of the first generation migrate to the opening buds where they feed principally on the leaf petioles and blossom stems. The nymphs of the later generations are found chiefly on the upper and under side of the foliage. They also occur to some extent on the tender wood, especially in the fall.

The nymphs secrete copious quantities of honeydew, and, as a general rule, are enveloped by this liquid. According to our observations, the nymphs of the first generation secrete less honeydew than those of the succeeding broods.

Molting: The nymph molts five times, attaining the adult stage after the fifth molt. In experiments with 39 individuals the average duration of each instar was: 1st instar 6 days; 2nd instar 6 days; 3rd instar 6 days; 4th instar 6 days; 5th instar 8 days.

Length of Nymphal Life: In experiments conducted with 192 individuals of the 1st generation, the duration of the nymphal stage varied from 20 to 35 days with an average of 28 days.

Further data on the duration of the nymphal stage of summer and winter forms are presented in Tables No. 3 and 4.

TABLE No. 3.

Length of Nymphal Life of Summer Forms.

Year.	Date of Hatching.	Generation.	Number of Individuals.	Duration. Max.	Min.	Aver.
				days	days	days
1917	May 11–31	1st	71	35	24	30
1917	June 5–30	1st, 2nd	40	24	19	21
1918	June 18–24	2nd	10	27	21	25½
Average	June 5–30	1st, 2nd	50	27	19	23
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	17
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12	22½
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	20
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	19	23

[illegible] Forms.

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...in.	Aver.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	days 21	days 23½
1917	Aug. 1–30	3rd	22	55	29	38
1918	Aug. 26–31	4th	11	51	30	43
Average	Aug. 1–31	3rd, 4th	33	55	29	40½
1917	Sept. 1–8	3rd	5	61	51	58

The Summer Adult.

The summer adult commences to appear a short time after the pear blossoms fall, and from then until early autumn it is always present.

Description: The adult (Fig. 18) is a tiny four-winged insect bearing a striking resemblance to a Cicada in miniature. The transparent wings slope roof-like over the abdomen, and the legs are adapted for jumping. The differences in the external appearance of the male and female are shown in Fig. 21. The female is about 2 mm. in length and the male about 1.8 mm.

Colour notes: Predominating colour red. Antennae yellowish brown: I, II reddish: tips black. Head crimson, mesal suture and a spot on either side black. Eyes dark red. Thorax crimson with black markings. Abdomen crimson with five black transverse bands. Legs pale yellowish brown. Front wings faintly clouded with yellow, veins pale yellowish brown, hind wings transparent.

Mating Habits: The female mates several times, and the male is polygamous. In copulating, the male gets along side the female on her right side, lifts his left wing to some extent, grasps the upper genital plate with his claspers and inserts the penis.

Preoviposition Period of Female: The average preoviposition period of confined females was 4 days in 1917 and 6 days in 1918, the minimum and maximum for both seasons being 3 days and 9 days respectively.

Reproductive Capacity of Female: According to our observations, one female may lay from 1 to 61 eggs per day.

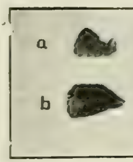

Fig. 20.—Abdomen of "*a*" male, and "*b*" female pear psylla. (Much enlarged.)

In our experiments the maximum production per insect was 695 eggs and the minimum 65 eggs. (See Table No. 5).

TABLE No. 5.

Showing Comparative Reproductive Capacity of Summer and Overwintering Females.

Year.	Generation (Summer).	Number of Couples used.	Egg Laying Period.	Reproductive Capacity of Female.		
				Max.	Min.	Aver.
				Eggs	Eggs	Eggs
1917..................	1st	7	June 19—Aug. 14.	671	427	540
1918..................	1st	5	June 7—July 25.	695	459	625
Average	1st	12	June 7—Aug. 14.	695	427	582
1917..................	2nd	10	July 23—Sept. 4.	684	65	343
1918..................	2nd	5	July 18—Sept. 10.	636	258	456
Average	2nd	15	July 18—Sept. 10.	684	65	399
1918..................	3rd	5	Aug. 15—Oct. 5.	285	86	193
1917..................	Winter	4	April 12—June 13.	448	121	279

Reproductive Period of Female: The average reproductive period of 17 females in 1917 was about 30 days and in 1918 with 15 individuals it was 36 days, the maximum and minimum for both seasons being respectively 63 days and 16 days.

Length of Adult Life: Our observations indicate that the average length of life of the male is about 5 weeks and that of the female a few days longer.

The Overwintering Adult.

Description: The overwintering adult can be readily distinguished from the summer adult by its larger size, darker coloration, and by its transparent front wings. The predominating colour of this form is black or dark brown. The female is about 2.43 mm. in length and the male about 2.16 mm.

Habits: In September, with the coming of autumn, the overwintering forms commence to appear, and their production is continued until the close of the season. They feed to some extent but do not mate or lay eggs. During the winter they hibernate chiefly beneath th … main limbs and also under grass, leaves and r … In late March of early April, with the comi … their winter quarters, congregate on the twig … ower central portions of the trees, and in a sh … ains propitious, they mate and commence to la … ring, and by the time the fruit buds have bu … s left on the trees. A few stragglers survive unti …

Egg Laying Period: The females usu … pril, and, by the time the fruit buds have burst, … ated individuals continue to oviposit up to th … y or early June.

Reproductive Capacity of Female: In … couples, the egg production per female varied from 121 eggs to 448 eggs, with an average of 279 eggs. Each female laid from 1 egg to 48 eggs per day.

Number of Generations.

In our insectary studies we obtained a maximum of four from the earliest laid eggs and a minimum of two generations from the last laid eggs. This would indicate, at least theoretically, that in the Niagara district there are two complete generations, a very large third generation and a small fourth generation.

Control.

Natural Control.

Several species of insects, notably ladybird beetles, attack the psylla and check its rapid multiplication to some extent. However, undoubtedly the most important control agency afforded by nature is the weather. Our observations indicate that protracted periods of cold, wet weather in spring may be disastrous to the eggs and newly hatched young. Hodgkiss records the destruction of hibernating forms in spring by ice storms, heavy washing rains, and sudden changes in temperature. Professor Brittain, in a letter dated September 23rd 1918, reports a great diminution of the psylla in Nova Scotia, which he thinks was caused by the hard winter of 1917-18. Long spells of hot, dry weather also appear to be fatal to many psyllas chiefly, we think, because such weather renders much of the foliage hard and dry and therefore unsuitable for the development of nymphs.

Artificial Control.

The fact that a combination of the delayed dormant spray of lime sulphur and the post blossom application of nicotine extract will control the psylla was demonstrated this year in a twelve-acre orchard of Bartlett, Duchess, Anjou and Flemish Beauty pears near Beamsville. This orchard had been subject to serious psylla injury for a number of years and last year it was very heavily infested. This spring myriads of hibernating adults were found in it on the twigs and branches and a very large deposition of eggs was made.

The dormant spray of lime sulphur (winter strength) was delayed until shortly before the blossoms opened (Fig. 21) and it was then applied with great thoroughness, care being taken to coat every part of the tree. At this stage, the

Fig. 21.—Showing stage of fruit bud development at the time of first application.

Fig. 22.—Blossoms fallen: time of second application.

vast majority of the eggs had been deposited and many of the earliest laid eggs had hatched. After the blossoms fell (Fig. 22), the trees were again thoroughly sprayed with lime sulphur and arsenate of lead (for scab and codling worm) and Black Leaf 40, ¾ pt. to 80 gals. of spray mixture, the latter of course being added to destroy the psylla nymphs. At this stage an odd winter adult and a very few belated eggs were still present on the trees.

Results: About two weeks after the delayed dormant spray was applied, an examination of the orchard was made and it was observed that although the vast bulk of the eggs and recently hatched nymphs had been destroyed, too many nymphs were still present. In other words, we found that the spray for the eggs would not by itself give us satisfactory control. The orchard was frequently inspected after the post blossom application and up to the time the Flemish Beauty pears were picked the trees were found to be practically free of psylla. Early in July, we examined trees situated in different parts of the orchard and on as much of the tree as could be conveniently looked over, we found from two

to nine psyllas per tree. At the end of August, the orchard was still practically free of psylla, the foilage was abundant and healthy green in colour, whereas in our check orchard the trees were heavily infested, all the foliage was spotted with brown and some of it was dead. The last examination of the treated orchard was made in late October and rather to our surprise, we found that the insect had increased to quite an extent and that the winter adults were fairly common.

Conclusions: Our results this year show that although the two applications will not eradicate the psylla, they will reduce it to insignificant proportions. To obtain absolute control, it seems to us in the light of our present knowledge, that it would be necessary to spray with nicotine extract two to three weeks after the calyx application in order to destroy the nymphs derived from belated eggs.

PROF. PARROTT: Pear Psylla is next to Blight the worst pest we have to contend with in the upkeep of our pear plantings, and the experience of Mr. Ross in the control of the insect resembles a great many of our experiences. Control varies with seasonal conditions, and the numbers of females that hang over to take part in the spring oviposition. It takes two sprays to give good commercial control. A great many experiments have been carried on both by the Station and by spraying experts and some years results have been almost perfect and in other years or in other experiments the results have not been so satisfactory.

MR. ROSS: I should like to ask Prof. Parrott if he can explain why the Pear Psylla never seems to be troublesome in small plantings.

PROF. PARROTT: I cannot explain it any more than I can understand why roadside trees are so free from it. I think it likes sheltered, and undisturbed areas in an orchard. As to what influences it I do not know.

CONTROL OF THE APPLE MAGGOT.

L. CAESAR AND W. A. ROSS.

A full account of all our tests of control measures against the Apple Maggot would require too long an article; hence we shall give only the outstanding points of interest and value.

In 1911 and 1912 the destruction of the fallen fruit was tested in a small, isolated, badly infested orchard, and gave fairly satisfactory results, but the labor involved was so great that it was seen that not many fruit growers could or would adopt the method and in many cases live stock could not be used for the purpose.

In 1913 we tried sweetened poison sprays on individual trees or groups of trees in the orchards and found that though the number of infested fruits compared with those on some of the checks was lessened yet the results were not satisfactory.

In 1914 believing that a larger continuous area should be sprayed we gave two applications of arsenate of lead and molasses to a 25 acre orchard at Mountain and left a narrow strip of about 2 acres along the east side as a check. Both check and sprayed portion had been badly infested the previous year and much of the fruit had been left on the ground.

RESULT: In the whole orchard, after an examination in September by both writers, less than a dozen infested apples were found. This no doubt would look like a case of natural control and in no way due to spraying; but such was not the case, because examination of the trees soon after the first application and again during the second showed that, though the flies were not abundant yet

sufficient were present to have punctured numerous apples even though the percentage thus injured might not have been high. Moreover, the season was very dry and the owner had sprayed the whole orchard, check and all, very heavily for Codling Moth. Much of this spray was still on the check trees at the time of the first application to the rest of the orchard. This together with the narrow width of the check strip and its closeness to the sprayed trees was sufficient to account for the destruction of the flies on the check.

In 1915 we sprayed a small orchard in Simcoe village, near which were other infested trees. The season was wet and seven applications were given, but in spite of these approximately 60 per cent. of the Tolmans, 20 per cent. of the Snows and 15 per cent of the Spies were punctured. These results showed that one could not hope to control the pest by spraying in a town without treating all trees for many rods on every side; especially would this be true if there were high winds to help in the dispersal of the insects.

We also sprayed in 1915 all of a small, isolated orchard at Villa Nova, which had been badly infested the previous year and most of the fruit of which had been left on the ground.

RESULT: Though the crop was very light, thus making it harder to protect, and though only two applications were given, which certainly were not sufficient for so wet a season, approximately only 12 per cent. of the fruit was infested; which was very encouraging.

In 1916 we sprayed with the sweetened poison two adjoining orchards on one side of the road at Lyn, near Brockville, and left another orchard about twenty-five rods away as a check. There was a hedge and also a house and barn situated between this orchard and the sprayed ones. On the opposite side of the road we sprayed a third orchard and left a check adjoining it and in the same direction as the other check. Two sprays were given. Many flies were seen in the sprayed orchards after the first spray and some during it.

RESULT: The two first-mentioned orchards had 95 per cent. or more of the fruit, including such susceptible varieties as Tolman, Wealthy and Snow, free from punctures, though most of the fruit the previous year had been so badly infested it was left on the ground to rot. The orchard on the opposite side of the road was not so clean, some of the Tolmans having as high as 25 per cent. of punctured apples, though most of these apples had only one or two punctures. The check orchards on both sides of the road showed that the Tolman, Snow, Wealthy and St. Lawrence, had from 75 per cent. to 95 per cent. of punctured apples, most of the apples having many punctures.

In 1917 we sprayed these same three orchards again, and to protect the one in which the results had not been quite satisfactory we sprayed a buffer area of about fifteen rods between it and the check.

RESULT: No punctures were found even on Snow, Alexander or Tolman, in the orchard farthest from the check. In the second orchard on this side of the road punctures were found on only one tree in the extreme north corner. The third orchard, the one on which there had been 25 per cent. of punctured Tolmans the previous year, was this year almost totally free from punctures, less than two score being found in the whole orchard. In the check orchards Snow, Wealthy and St. Lawrence and a heavily laden wild apple tree had almost every apple punctured. There was practically no crop on the Tolmans in the check orchard this year.

In this same year (1917) we also sprayed a small, old orchard north of Trenton,

which had been badly infested the previous year. The results here, too, were very satisfactory, only a very few apples being punctured, and nearly all of these on trees situated at some distance from the main orchard and near two trees that had received only one partial spraying.

In the fall of 1917 we found the worst infested apple orchard that we had yet seen. It consisted of nearly three hundred trees, including Snow, Wealthy, Tolman, Belleflower, Ben Davis and half a dozen other varieties. There had been a good crop, which if clean should have been worth $1,000 at least, but every apple that we could find on any variety was punctured by the insect and nearly all of them so badly punctured as to be conspicuously deformed. We therefore decided to make this orchard our final test. In 1918 it was given the regular sprayings for Apple Scab and Codling Moth, and then two extra fairly heavy applications for the Apple Maggot, the first of these being on the 12th and 13th of July and the next the first week in August. Orchards close by were sprayed to act as buffer orchards.

Results: The whole orchard was beautifully free from Scab and Codling Moth, and the effect upon the Apple Maggot was a clear demonstration of the power of poison sprays to control this pest: for instead of 100 per cent. of punctured fruit there was less than 5 per cent. Apple buyers, fruit growers and everybody who visited the orchard this year and had seen it last year were convinced that our method was as nearly perfect as anyone could hope for. There is no doubt at all that without the spraying the crop would have been ruined by the Apple Maggot, for one of the writers visited the orchard every few days from the time the flies began to emerge up to the end of July, and saw that they were very abundant. It was no trouble to capture twenty or more on a single tree in an hour even without a net. Moreover, a neighbouring orchard used as a check but so situated as not to endanger our test orchard was also visited frequently to see how many flies were present. (This orchard had not been badly infested the previous year and the fruit on it had been sold.) Eight or ten flies was the largest number seen on any one day: yet at the end of the season the Snows, Wealthy, Ben Davis and Phoenix in this orchard had 75 per cent. of the fruit infested, in fact so bad was the fruit that the chief apple buyer of the district, who had bought the fruit on the test orchard, absolutely refused to buy the crop on the check, declaring that it was worthless. It may be of value to note that though so many flies were seen in the sprayed orchard yet at no time were they observed copulating or ovipositing, whereas in the check orchard oviposition was observed on several occasions and egg punctures could be readily found before the end of July. No egg punctures were visible in the sprayed orchard at this date or at the time of the second spraying, all having evidently been made much later.

Conclusions.

The results of our field tests conducted in various parts of Ontario and spread over five consecutive years and corroborated by laboratory tests justify us, we believe, in stating confidently that the Apple Maggot can be successfully controlled in apple orchards by spraying.

The first application should be given just before or as the adults begin to emerge, which in the south-western part of the Province is about the last week in June, and in the parts with a somewhat colder climate such as Guelph, Stratford and the district all along Lake Ontario, about the first week of July, and in the

still colder parts such as Ottawa and the St. Lawrence River valley about the second week in July.

The second application should be made when the first has begun to disappear or usually in from two to three weeks. In wet seasons like the summer of 1915, a third application about ten days after the second will be necessary. Two years should almost completely destroy the insect in any orchard provided that infested orchards are not situated close by. In such case every effort should be made to have these treated also.

In all orchards every tree whether bearing fruit or not should be sprayed, because the adults often frequent such trees until egg laying begins.

As to the mixture to use, in 1914, 1915, and 1916 we used molasses along with arsenate of lead, but in 1917 and 1918 omitted the molasses and found that the results were equally good. This is fortunate, for molasses tends to cause the spray to wash off more quickly, sometimes burns the foliage, adds to the cost, and may cause complaints from beekeepers, though these complaints are not justified. We therefore recommend the use of from two to three pounds of the paste form or one to one and a half pounds of the powder form of arsenate of lead to forty gallons of water. We believe that heavy rather than light applications of the mixture should be made, especially if only two are given, because adults continue to emerge for a period of six weeks or more, and so the poison must remain on the trees to kill them before they can lay their eggs. Heavy applications remain on longer than light.

OUR GARDEN SLUGS.

Geo. Maheux, Quebec.

It is only during about the past thirty years that the Mollusks of the Province of Quebec have attracted the attention of naturalists and have been the object of their studies. As long as they remained inoffensive, or nearly so, they were objects of interest only to amateurs, on account of their strange forms, some presenting the richest of garments, of admirable color and composition, while others are of a viscous and almost repulsive nakedness. The day these *Mollusca Gasteropoda* came to feed in our vegetable gardens their economical stature changed hastily and the extent of their havoc soon necessitated the interference of zoologists. Of course, the first thing was to acquaint oneself with the species composing this branch of invertebrates; specialists devoted themselves to this study and systematic treatises were soon published; and from this departure, experimentalists endeavored to discover an efficient remedy against these new ravagers.

In 1890, very few text-books bearing on this subject were in existence, except, perhaps, the Manual of Conchology of Tryon, then published by Mr. Pilsbury, of Philadelphia, and a few other works of smaller importance. The following year (1891) our great Canadian naturalist, Abbé Provancher, published a new part of his Canadian Fauna, an illustrated book of over 150 pages, under the title of: "Les Mollusques de la Province de Quebec," Part I; Pteropoda, Cephalopoda and Gasteropoda. Provancher had been, for a long time, collecting specimens of these animals. From his book entitled: "Voyage aux Antilles," we can see that he was taking a great interest in this study and that he then made a large gathering of remarkable shells.

In our days, conchologists are rather numerous and with them the science of mollusks has enormously advanced. However, those who are interested in economic zoology, in the relations of beasts with cultivated plants particularly, still have much to learn as regards their habits, the noxiousness and the destructive work of our garden slugs.

The summer of 1918 seems to have been very propitious to observers and experimentalists. Slugs have increased in number in 12 months and their destructive work has developed. Many "war gardens" in the vicinity of Quebec have had to stand the attacks of these destroyers, usually unknown to average people, in this capacity at least. We might say that we have very often seen considerable damage; amateur gardeners were so much the more puzzled because they could not see the culprit at work. The ordinary species found in our gardens are: *Limax campestris, L. agrestis, L. maximus.*

The three of them seem to operate in the same manner. Everywhere they have injured several kinds of vegetables, never all at a time but rather one after the other. Is this a question of inclination, of caprice, of instinct or hazard? All hypotheses are allowed, and each of these agents probably has some influence upon the work, the choice of the beast.

The following is the order followed by the slugs and the vegetables they successively infested:

1. *Beans.*—The first vegetable infested everywhere, the slug only changing its food when this first plant has become inadequate.

2. *Peas.*—The relationship between beans and peas no doubt explains this transition and the appetite of the ravager.

3. *Turnips.*—After leaving peas, slugs spend most of the summer on turnip leaves, into which they cut large holes, with different contours.

4. *Cabbages and Cauliflowers.*—These crucifers equally attract slugs. At first, they are only seen on turnips, then upon all of them simultaneously.

5. *Pumpkins.*—Towards the end of the season, when the pumpkin has assumed a good round shape and is swelled with juice, the slug penetrates into the pulp and bores holes often as much as two inches deep.

Authors have noted the preference of slugs for cucumbers. For one reason or another, their presence upon this plant has nowhere been noticed by us, although, in most cases, the latter were close neighbors to turnips thoroughly infested by slugs.

The places they like best are gardens with a damp soil, naturally wet or kept in that condition artificially.

The slug does not only eat the plants at night; the weather seems to direct its line of conduct. We have seen slugs at work at night, after its coolness began to be felt; this is evidently the most common habit. The darkness of the night, however, is not indispensable to the coming out of these animals. They willingly show up when it is raining; if the sky is cloudy and the humidity of the air high, they will sometimes be seen upon the leaves. Their presence can even be noticed in the daytime, when the sun is shining brightly, on parts of vegetables that are well shaded and where the moisture will easily be retained, as, for instance, between rows of peas that have grown high and thick. It seems that the only factor essential to their activity is moisture and the absence of a bright light. Moreover, this is very easy to ascertain by a simple experiment: if vegetables are watered at the close of day, they come out almost immediately and much earlier than usual.

The damage done by the slug varies with the various plants on which it feeds, according to their age and consistency. Amongst the vegetables above mentioned, it is obvious that the youngest are the most badly infested.

Thus, beans had only grown three or four leaves when slugs started eating them up; after 8 or 10 days a dried stem was all that was left. It resulted that 50 per cent. of the plants did not bear any crop and 25 per cent. of the remainder only yielded one-third or one-half of the normal crop; one-fourth only was left intact or at least strong enough to bloom normally and yield accordingly. In a field where there were several varieties, the Burpee beans were completely cut down.

The crop of peas has only suffered a small diminution. When slugs launched an attack upon their stems, they were already nearing ripeness and had attained a remarkable degree of resistance. There has been a loss of a few leaves and pods, or a total loss of about 2 per cent.

Of the crucifers, cauliflowers are the only ones that seem to have been injured, and then only when the slugs were successful in penetrating into the fruit. Finally, in the case of pumpkins, there still remained the expedient of removing the injured part, the sides of the hole bored by the slug.

Control.—The following substances were used: Paris green, arsenate of lead, Bordeaux mixture, quicklime (powder).

The first two insecticides only gave poor results; they did not seem to diminish the number of slugs in an appreciable degree.

Bordeaux mixture containing 6 lbs. of lime to 4 lbs. of bluestone makes slugs uneasy, kills a few of them slowly, but does not constitute an efficient means of destruction.

Quicklime has done wonderfully well. It has been dusted on the infested plants, in the following way:

1. At night, before slugs appear; in order that the success be complete, it is important that all issues leading to the plant be closed to the slug, which is not always an easy task.

2. At night, when the slugs are feeding upon the foliage. In this way the best results are achieved. If we can apply lime to come into close contact with the skin of the slug, the latter will die rapidly. The following morning, their inert bodies, reduced by one-half, of a dark green color, are still sticking to the leaves.

3. Applied during the day, lime loses its efficiency, because the coolness of the night lessens its strength.

As a rule, dusted lime retains its destructive power, in whole or in part, as long as it does not rain; it is excellent in a fresh condition. A small particle of lime is then sufficient to kill a slug. We have watched the doings of 12 slugs placed on a board and surrounded by a wall of lime, one-quarter of an inch in height. Not a single one was successful in getting over the obstacle; as soon as they came into contact with lime, they twisted convulsively and died in the space of 2 to 60 minutes, according as the injured part was more or less great or sensible. Secretions very abundant at first, soon become nil, coinciding with the complete absence of movement.

It would be very difficult to find a more energetic remedy and of easier application. By repeating the dusting of lime, particularly at night, these destroyers will soon be controlled.

Several other remedies are, however, to be found. In reading I happened to come across several of them, a few of which are herewith described to bring this study to an end, and thinking that it might interest you.

In his book, "Recettes et Procédés," Tissandier recommends the following mixture, spread on the ground.

Caustic soda	40 gr.
Quicklime	960 gr.

Bellet in "Les meilleures Recettes" say that in order to destroy slugs, it is sufficient to spray the spots visited by these parasites, with a solution of 600 grammes of carbonate of soda dissolved in one litre of water.

Mr. Anadyx surrounds the stem of vegetables with a border of old newspapers and slugs disappear. ("La Nature," 1904.)

Mr. Noel, of the Rouen laboratory of agricultural entomology, after several tests, states that the most efficient destructive agent is copper arsenite. He prepares it in the following manner: He mixes 1 kilogram of coarse wheat bran, 100 grammes of copper arsenite and about 250 cubic centimetres of water. When the whole has assumed the form of a consistent paste, little balls are made and distributed on the ground where slugs are expected to be found. After one week, they will practically all have disappeared. (La Nature, 1910.)

In order to attract slugs, Mr. Hardys covers cabbage leaves with rancid butter and places them here and there in the garden: the next morning they are thoroughly covered with slugs which are then easily destroyed.

Finally, if the chickens are allowed in the garden, they can render valuable services, but they must not be given dead slugs as food; they should be burnt and buried deep.

We did not have the necessary time to try all these remedies; but we place them before you for consideration. No doubt several experimentalists in this assembly will want to give them a trial. The result of their experiments will certainly be both useful and interesting.

THE ENTOMOLOGICAL RECORD, 1918.

ARTHUR GIBSON, ENTOMOLOGICAL BRANCH, DEPARTMENT OF AGRICULTURE, OTTAWA.

The Record for 1918, as will be seen, presents data regarding distribution chiefly in the orders Lepidoptera, Coleoptera, and Diptera. No extensive collections, so far as I know, have recently been made in the less known orders.

During 1918 the insects collected by members of the Canadian Arctic Expedition during the years 1913-1916, have been worked over by various specialists, and it is hoped the results of these studies will soon be available in published form. These reports will make a valuable addition to our knowledge of the insects of Arctic Canada.

As in other years, students of insects in Canada have received much assistance from various specialists, chiefly those resident in the United States. The list of these specialists is every year assuming greater length, and it therefore becomes difficult to specially mention any of our good friends to the South. All who have assisted us in our systematic studies have our grateful thanks.

LITERATURE.

Among the books, memoirs, etc., which have appeared during 1918, of interest to Canadian students, the following may be mentioned:

BARNES, W., and McDUNNOUGH, J. Life-histories of North American Species of the genus Catocala: Bull. Amer. Mus. Nat. Hist., XXXVIII, Art. V, pp. 147-177, March 21, 1918. This paper, which was published in anticipation of the "Illustrations of the North American Species of the Genus Catocala," will be valued by those doing life-history work. The ova of a number of the species described were received from Canada, and for this reason the paper is of much interest to our workers.

BARNES, W., and McDUNNOUGH, J. Illustrations of the North American Species of the Genus Catocala, by Wm. Beutenmuller, with additional Plates and Text. Memoirs of the Amer. Mus. Nat. History, New Series, Vol. III, Part I, October, 1918. This most excellent memoir was received with much pleasure. We had long known that Mr. Beutenmuller had contemplated such a work and it was fortunate that Messrs. Barnes and McDunnough had his manuscript and some of the plates before them. Pages 1 to 47 are given up to the text. Under each species references to the literature are given, as well as notes on the synonomy and distribution. Under each section and group structural and life-history notes are given. The plates are excellent. I to IX and part of X illustrate adults. Nineteen larval heads are shown on plate X. Plates XI to XIV illustrate mature larvæ. On plate XV there are 25 further figures of head capsuls and 16 drawings of segments. Plates XVI and XVII also show segments. Genetalic drawings are reproduced on plates XVIII to XXII. Plates I to XVII are in colours. Lepidopterists generally will welcome the appearance of this memoir. It is indeed an important contribution.

BARNES, W., and McDUNNOUGH, J. H. Contributions to the Natural History of the Lepidoptera of North America. Vol. IV, No. 2—Notes and New Species. This number of the "Contributions," pp. 61-208, plates XI to XXV, is a valuable

addition to the literature. Four new species are described from Canada and one new variety. There is a decided improvement in the plates which accompany the number.

Casey, Thos. L. Memoirs on the Coleoptera, VIII, issued Nov. 12, 1918. The New Era Printing Co., Lancaster, Pa. This large memoir of 427 pages is the result of studies of certain groups, the species in which are closely related. It is divided as follows: I—A Review of the North American Bembidiinæ (pp. 1-223); II—Studies among some of the American Amarinæ and Pterostichinæ (pp. 224-293); III—Observations on the American Pogoninæ, including Trechus (pp. 394-412); IV—Miscellaneous Notes and Corrections (413-416). In the Memoir, 26 new species are described from Canada, all from British Columbia, excepting one from Ontario. In addition a number of Canadian records of previously known species are included.

Comstock, J. H. The Wings of Insects. The Comstock Publishing Co., pp. xviii-423, 9 plates, 427 figs. This important publication is one which has been well received by entomologists generally. Space here forbids us referring at any length to this work. I would refer the reader to a review of the book which was published in the February, 1919, issue of *The Canadian Entomologist*. The price is $3.75.

Felt, Ephraim Porter. Key to American Insect Galls. New York State Museum, Bulletin No. 200. This a most valuable publication of 310 pages, freely illustrated with good text drawings, in addition to which there are sixteen half-tone plates. Entomologists generally will, indeed, be grateful to Dr. Felt for completing this very useful work. With this publication there is an excellent opportunity for Canadian students to add to the known knowledge of these interesting insects.

Lochhead, William. Class Book of Economic Entomology, with special reference to the economic insects of the Northern United States and Canada. Philadelphia, P. Blakiston's Son & Co., 436 pp., 257 illustrations; price $2.50. This new book on economic entomology will certainly find a useful place among economic workers. The descriptions are concise and to the point, the illustrations well chosen and the printing excellent. Part I discusses the structure, growth and economics of insects; Part II the identification of insects injurious to farm, garden and orchard crops, etc., Part III, the classification and description of common insects; Part IV, the control of injurious insects.

Lutz, Frank E. Field Book of Insects. G. P. Putnam's Sons, New York and London; with about 800 illustrations, many in colour. This field book of a size to fit the pocket is full of useful information. Following introductory remarks, pages 9 to 27 discuss collecting and preserving insects. Then follow chapters on the various orders, under each of which concise information is presented. The volume is one of 509 pages, freely illustrated, many of the figures being coloured.

Pettit, R. H. and McDaniel, Eugenia. Key to Orthoptera of Michigan with Annotations. Special Bull. No. 83, Mich. Agric. College, Jan., 1918. This publication of 48 pages will prove of interest to collectors and students in Canada. In addition to a key to the families of Michigan Orthoptera, it also contains generic and specific keys. Useful illustrations are included.

Piers, Harry. The Orthoptera (Cockroaches, Locusts, Grasshoppers and Crickets) of Nova Scotia, with descriptions of the species and notes on their occurrence and habits. Halifax, N.S., Trans. N.S. Inst. Sci. Vol. XIV, Part 3, pp. 201-356, 4 plates; author's separates published 15 July, 1918. Such provincial contri-

butions are of much interest and will undoubtedly assist in a better knowledge of the species. Descriptions of all the Nova Scotia species are given, with keys to assist in more ready identification. The economic species are discussed at greater length.

RAU, PHIL, and RAU, NELLIE. Wasp Studies Afield. Introduction by W. M. Wheeler. Princeton University Press; price $2.00. This volume of 368 pages contains most interesting information on the habits of wasps that build their nests in burrows. The chapter headings are: Some Bembicene Wasps; Behaviour of Wasps belonging to the Family Pomphilidæ; Some Fly-catching Wasps; The Bee-killing Wasps; Some Mud-daubing Wasps; The Hunters of Small Orthoptera; The Hunters of Large Orthoptera; The Sand-loving Ammophila; Some Social Wasps—Experiments on the Homing of *Polistes pallipes*; The Mining and other Wasps of the Family Eumenidæ; General Considerations.

SWAINE, J. M. Canadian Bark-beetles, Part II, a preliminary classification with an account of the habits and means of control. Bull. No. 14, Ent. Br., Dept. Agriculture, Ottawa, issued Sept. 6, 1918. This bulletin was prepared with the object of assisting students and practical foresters in determining the bark-beetles of Canadian forests. Part I discusses "The Beetles and Their Habits"; Part II "Bark-beetle Injuries and the Means of Control"; Part III "Structural Characters of the Bark-beetles"; and Part IV "Classification—A preliminary Arrangement of the Canadian Bark-beetles." Thirty-one plates and several figures in the text add great value to the publication. This, the most important publication on these insects, will be invaluable to entomologists generally.

WASHBURN, F. L. Injurious Insects and Useful Birds. Philadelphia and London: J. B. Lippincott Co., 414 illustrations in text and 4 coloured plates. Price $2.00. This volume, although prepared particularly for high schools and agricultural colleges, will be a useful work of reference for amateur entomologists, gardeners, and farmers generally. Chapters I to VI deal with losses due to insects and rodents, etc.; chapters VII to XVIII discuss insects affecting various crops. Chapter XIX, "Our Insect Friends," XX, "The Relation of Birds to Agriculture," and XXI, "Some Four-footed Pests of the Farm," complete the volume.

WILSON, H. F., and VICKERY, R. A. A species list of the Aphididæ of the World and their Recorded Food Plants. Reprinted from the Transactions of the Wisconsin Academy of Sciences, Arts and Letters, Vol. XIX, part I; issued Nov. 1918, pp. 22-355. This is divided into two parts; Part I—A species list of the Aphididæ of the world with their recorded food plants; Part II—A list of Aphid food plants and the Aphids said to attack them. Students of aphids will find this publication of great value. It is indeed an important contribution.

NOTES OF CAPTURES.

LEPIDOPTERA.

(Arranged according to Barnes and McDunnough's Check List of the Lepidoptera of North America.)

Pieridæ.

35. *Pieris napi pseudonapi* B. & McD. Blairmore, Alta., June, (K. Bowman).
46. *Anthocharis sara julia* Edw. Blairmore, Alta., June, (K. Bowman).
64. *Eurymus christina gigantea* Stkr. Mile 214, 332, H. B. Ry., Man., July, 1917, (J. B. Wallis).

68. *Eurymus palaeno chippewa* Edw. Mile 214, 332, H. B. Ry., Man., July, 1917, (J. B. Wallis).

Satyridæ.

122. *Oeneis chryxus calais* Scudd. Mile 332, H. B. Ry., Man. July, 1917, (J. B. Wallis).

Nymphalidæ.

172. *Argynnis edwardsi* Reak. Blairmore, Alta., June, (K. Bowman).
173. *Argynnis platina* Skin. Blairmore, Alta., June, (K. Bowman).
198. *Brenthis youngi* Holl. In the Entomological Record for 1917, this species was recorded from Klutlan Glacier, Y. T. On further study the specimen proves to be *Brenthis frigga* var. *improba* Butl.
200. *Brenthis epithore* Bdv. Blairmore, Alta., June, (K. Bowman).
220. *Euphydryas gilletti* Barnes. Nordegg, Alta., July, (K. Bowman).
226. *Melitaea palla* Bdv. Blairmore, Alta., June, (K. Bowman).
279. *Aglais californica* Bdv. Regarding this species Mr. F. C. Whitehouse sends the following note: "Red Deer, Alta., mid-June, large migratory flight of presumably hibernated insects from B.C.; mid-August, new brood appeared.
313. *Chlorippe clyton* Bdv. & Lec. Pt. Pelee, Ont., Aug. 14, 1909, (P. A. Taverner).

Lycaenidæ.

411. *Heodes cupreus* Edw. Mt. McLean, B.C., 7,000 feet, and at head of Phair Creek, about 30 miles from Lillooet, B.C., (A. W. A. Phair).
427. *Plebeius melissa* Edw. Goldstream, B.C., July 3, 1918, (E. H. Blackmore). Rather rare. This species was not included in the "Check List of B. C. Lepidoptera, 1906," for some unaccountable reason, as it occurs regularly throughout the interior, although it is very common on Vancouver Island (E.H.B.).
432. *Plebeius yukona* Holl. Mile 332, H. B. Ry., Man., July, 1917, (J. B. Wallis).
433. *Plebeius icarioides pembina* Edw. Blairmore, Alta., June, (K. Bowman).

Sphingidæ.

733. *Haemorrhagia gracilis* G. & R. Nipigon, Ont., (J. Fletcher).
741. *Pholus fasciatus* Sulz. Annapolis Royal, N.S., Oct. 31, 1918, (A. Kelsall). This is a beautiful specimen and is now in the Ottawa collection. It is the only Canadian example I have seen, (A. G.).

Arctiidæ.

892. *Clemensia albata* Pack. Edmonton, Alta., Aug. 1917, (D. Mackie).
939. *Dodia albertæ* Dyar. Mile 214, H. B. Ry., Man., July, 1917, (J. B. Wallis).
948b. *Phragmatobia fuliginosa borealis* Staud. Vernon, B.C., April 26, 1918, (M. Ruhmann). I have also a specimen taken at Vancouver, B.C., on April 23, 1907, by the late Captain R. V. Harvey. These are the only two specimens known to me and constitute a new addition to the B.C. List. (E. H. B.).
955. *Diacrisia vagans kasloa* Dyar. Blairmore, Alta., June, (K. Bowman).
956. *Diacrisia rubra* Neum. Edmonton, Alta., June, 1916, (D. Mackie).
962. *Estigmene prima* Slosson. Edmonton, Alta. and Red Deer, Alta., May-June, 1916, (K. Bowman).

Noctuidæ.

1214. *Copablepharon viridisparsa* Dod. Lillooet, B.C., Aug. 24, 1916, (A. W. A. Phair). One specimen a trifle worn. New to B.C., originally described from Lethbridge, Alta., (E.H.B.).

1313. *Euxoa ontario* Sm. Edmonton, Alta., and Pocahontas, Alta., July-August, 1916-1917, (K. Bowman and D. Mackie).

1315. *Euxoa quinquelinea* Sm. Rossland, B.C. No date. (W. H. Danby). New to B.C., (E.H.B.).

1315a. *Euxoa quinquelinea lutulenta* Sm. Okanagan Landing, B.C., August 25, 1915, (J. A. Munro). New to B.C., (E.H.B.).

1353a. *Euxoa divergens abar* Stkr. Duncan, B.C., June 29, 1896, (E. M. Skinner). New to B.C., (E.H.B.).

1357. *Euxoa redimicula* Morr. Atlin, B.C., Aug. 8, 1914, (E. M. Anderson). This is an interesting record as showing the far northern range of this species. (E.H.B.).

1379. *Chorizagrotis thanatologia* Dyar. Ottawa, Ont., June 28, July 7, 1899, (C. H. Young); Ottawa, June 29, 1905, (J. Fletcher); Strathroy, Ont., July 4, 1918, (H. F. Hudson). These specimens are very close to the variety *sordida* Sm., as figured by Dod, but are slightly redder. Wellington, B.C., (G. W. Taylor). This specimen is close to Dod's figure of *boretha* (Can. Ent. XLVIII, p. 4, f. 7).

1445. *Agrotis esurialis* Grt. Duncan, B.C., June 4, 1910, (G. O. Day).

1459. *Agrotis atrata* Morr. Nordegg, Alta., July, 1917, (K. Bowman).

1468. *Pseudorthosia variabilis* Grt. Blairmore, Alta., Sept., (K. Bowman).

1502. *Lycophotia lubricans* Gn. Ottawa, Ont., July 2, 1908, (C. H. Young).

1512. *Aplectoides arufa* Sm. Pocahontas, Alta., Aug., 1916, (K. Bowman).

1513. *Aplectoides condita* Gn. Edmonton, Alta., June, 1916-1917, (D. Mackie and K. Bowman).

1529. *Anytus enthea* Grt. Edmonton, Alta., Sept., 1916, (K. Bowman).

1538. *Anomogyna sincera* H.S. Nordegg, Alta., July, 1917, (K. Bowman).

1539. *Anomogyna laetabilis* Zett. Pocahontas and Nordegg, Alta., July-Aug., (K. Bowman).

1580. *Rhynchagrotis vittifrons* Grt. Penticton, B.C., (L. A. DeWolfe). Lillooet, B.C., Oct. 19, 1917, (A. W. A. Phair). New to B.C., (E.H.B.).

1682. *Polia negussa* Sm. Rossland, B.C., no date, (W. H. Danby). New to B.C., (E.H.B.).

1693. *Polia cristifera* Wlk. Edmonton, Alta., and Pocahontas, Alta., June, 1917, (K. Bowman and D. Mackie).

1697. *Polia rogenhoferi* Moesch. Nordegg, Alta., July, 1917, (K. Bowman).

1702. *Polia variolata* Sm. Victoria, B.C., July 18, 1918, (E. H. Blackmore). Taken at rest on a fence at mid-day. There is one specimen in the Provincial Museum collection taken at Victoria in 1902. Outside of these two specimens I have no further record from B.C., (E.H.B.).

1723. *Polia pulverulenta* Sm. Aweme, Man., June 1, 1918, (N. Criddle); McNab's Island, Halifax, N.S., June 30, 1914, (J. Perrin).

1734. *Polia vicina* Grt. Okanagan Landing, B.C., Aug. 5, 1916, (J. A. Munro). This is the same species which has been previously listed from Kaslo as *pensilis* Grt., the latter species only occurring on Vancouver Island and in the Lower Fraser Valley, (E.H.B.).

2001. *Cucullia omissa* Dod. Ottawa, Ont., June 5, 1906, (C. H. Young).

2018. *Oncocnemis hayesi* Grt. Blairmore, Alta., Sept., (K. Bowman).

2061. *Oncocnemis atrifasciata* Morr. Laterriere, Chicoutimi, Que., Aug. 25, 1878, (V. A. Huard). I recently determined this specimen and am assured it was captured at this place, (A.G.).

2098. *Momophana comstocki* Grt. Near Quebec City, Que., (V. A. Huard).

2125. *Hillia discinigra* Wlk. Edmonton, Alta., Aug., 1916, (D. Mackie).

2168. *Graptolitha thaxteri* Grt. Edmonton, Alta., Sept., 1916-1917, (D. Mackie).

2170. *Xylena mertena* Sm. Lillooet, B.C., (A. W. A. Phair).

2172. *Xylena brillians* Ottol. Edmonton, Alta., Sept., 1917, (D. Mackie).

2185. *Pleroma cinerea* Sm. Lillooet, B.C., May 4, 1916, (E. M. Anderson); Armstrong, B.C., no date, (W. Downes).

2279. *Trachea parcata* Sm. Nordegg, Alta., July, 1917, (K. Bowman).

2315. *Trachea impulsa* Gn. Victoria, B.C., July 6, 1918, (E. H. Blackmore). First record from Vancouver Island, previously recorded from Kaslo, (E.H.B.).

2343. *Oligia includens* Wlk. Edmonton, Alta., July-Sept., 1916-17, (K. Bowman and D. Mackie).

2359. *Eremobia claudens* Wlk. Hymers, Ont., Aug. 16, 30, 1913, (H. Dawson).

2502. *Acronycta lithospila* Grt. Chelsea, Que, June 29, 1917, (J. H. McDunnough).

Xylomœa chagnoni B. & McD. Ottawa, July 13, 1908, (C. H. Young); Trenton, Ont., 1899, (J. D. Evans). In the Ent. Record for 1905, this recently described species is recorded under the name of *Hadena didonea* Sm., the specimens having been reared by Fletcher from larvæ found in the roots of *Phalaris arundinacea*.

2524. *Andropolia aedon* Grt. Duncan, B.C., no date, (E. M. Skinner). New to B.C., (E.H.B.).

2781. *Arzama obliqua* Wlk. Duncan, B.C., June 26, 1906, (E. M. Skinner). One specimen in splendid condition; new to B.C., (E.H.B.).

* *Catocala atala* Cassino. Hymers, Ont., Sept. 18, 1911; Lepidopterist, II, 52.

* *Catocala briseis clarissima* Beut. Cartwright, Man., (Heath); Winnipeg, Man., (J. B. Wallis); Lepidopterist, II, 66.

* *Catocala blandula manitobense* Cassino. Cartwright, Man., July 17; Lepidopterist, II, 81.

3109. *Catocala blandula* Hlst. Red Deer, Alta., August, 1905, (K. Bowman); Ottawa, Ont., July 26, 1906, (C. H. Young).

3207. *Panthea acronyctoides* Wlk. Onah, Man., July 9, 1918, (N. Criddle, J. B. Wallis and L. H. Roberts).

3245. *Autographa v-alba* Ottol. Rossland, B.C., no date, (W. H. Danby). Only B.C., previous record from Kaslo, (E.H.B.).

3272. *Autographa metallica* Grt. Victoria, B.C., June 21, 1918, (E. H. Blackmore). First record from Victoria, B.C., that I know of, (E.H.B.).

* *Syneda hudsonica heathi* B. & McD. Cartwright, Man., June, (E. F. Heath); Cont. Nat. Hist. Lep. N.A., IV, 2, 122.

3434. *Rivula propinqualis* Gn. Edmonton, Alta., July, 1917, (K. Bowman).

Parahypenodes quadralis B & McD. Trenton, Ont., Aug. 30, 1908, (J. D. Evans).

3511. *Zanclognatha lutalba* Sm. Edmonton, Alta., July, 1915-1917, (K. Bowman and D. Mackie).

3580. *Hypena californica* Behr. Edmonton, Alta., Sept., 1917, (D. Mackie).
* *Parahypenodes quadralis* B. & McD. St. Therese Island, St. John's Co., Que., July, (W. Chagnon); Cont. Nat. Hist. Lep. N.A., IV, 2,124.

Notodontidæ.

3669. *Cerura borealis* Bdv. Edmonton, Alta., June-July, 1916-1917, (D. Mackie and K. Bowman).
3670. *Cerura occidentalis* Lint. Nordegg, Alta., and Pocahontas, Alta., July-August, (K. Bowman).

Lymantriidæ.

3704. *Hemerocampa vetusta gulosa* Hy. Edw. Chase, B.C., Aug. 4-6, 1917, (W. B. Anderson).

Geometridæ.

3802. *Synchlora rubrifrontaria* Pack. Edmonton, Alta., July, 1917, (D. Mackie).
3936. *Stamnoctenis morrisata* Hulst. Goldstream, B.C., July 5, 1918—July 8, 1918, two males, (E. H. Blackmore). First record from here: recorded from Duncan, B.C., last year by A. W. Hanham, which was the first record from Vancouver Island, (E.H.B.).
3950. *Acasis viridata* Pack. Edmonton, Alta., May, 1915-1916, (D. Mackie).
3955. *Cladura atrolliturata* Wlk. Edmonton, Alta., April-May, 1915-1916, (K. Bowman and D. Mackie).
* *Eustroma fasciata* B. & McD. Cowichan Lake, Vancouver Island, B.C., June; Cont. Lep. N.A., Vol. IV, 2, 137.
3981. *Lygris destinata lugubrata* Moesch. Edmonton, Alta., July-August, 1915-1917, (D. Mackie).
3983. *Lygris explanata cunigerata* Wlk. Edmonton, Alta., July-August, 1915-1917, (D. Mackie).
* *Lygris xylina serrataria* B. & McD. Ottawa, Ont., (C. H. Young).
* *Thera georgii benesignata* B. & McD. Wellington, B.C., July 28, 1905, Sept. 12, 1903; Duncan, B.C.; Cont. Lep. N.A. III, No. 4, 226.
3987a. *Diactinia silaceata albolineata* Pack. Victoria, B.C., April 30, 1918—July 24, 1918, (E. H. Blackmore). First record from Victoria, (E.H.B).
3993. *Dysstroma citrata* L. Pocahontas, Alta., Aug., 1917, (K. Bowman).
3995. *Dysstroma walkerata* Pears. Nordegg, Alta., July, 1917, (K. Bowman).
* *Hydriomena macdunnoughi* Swett. Atlin, B.C., June 11, 1914; Can. Ent. L, 296.
* *Xanthorhoe blackmorei* Swett. Victoria, B.C., May 2, 19, 1915, (E.H. Blackmore); Can. Ent. L, 21.
* *Xanthorhoe macdunnoughi* Swett. Victoria, B.C., May 30, 1915; May 14, 1913; (E. H. Blackmore); Duncan, B.C., (in coll. E.H.B.); Can. Ent. L, 17.
* *Xanthorhoe atlinensis* Swett. Atlin, B.C., June 26, 28, 1914; Can. Ent. L, 20.
4050. *Xanthorhoe iduata* Gn. Edmonton, Alta., June-July, 1915-1916, (D. Mackie).
4060. *Entephria aurata* Pack. Edmonton, Alta., July, 1915, (D. Mackie).
* *Oporinia autumnata henshawi* Swett. London, Ont., (Miss E. Morton and J. A. Moffatt); Lepidopterist, I, 47, (1917).

4077. *Euphyia luctuata* Schiff. Victoria, B.C., June 14, 1917, (W. Downes). First record from Victoria, (E.H.B.).

* *Epirrhoe plebeculata vivida* B. & McD. Wellington and Goldstream, B.C.; Cont. Lep. N.A., III, No. 4, 232.

4094. *Perizoma basaliata grandis* Hlst. Edmonton, Alta., July, 1915-1916, (D. Mackie).

4114. *Venusia cambrica* Curt. Edmonton, Alta., July, 1915, (D. Mackie).

4122. *Edule mendica* Wlk. Edmonton, Alta., June-July, 1915-1917, (K. Bowman and D. Mackie).

4137. *Eupithecia albipunctata* Haw. Edmonton, Alta., July, 1917, (D. Mackie).

4168. *Eupithecia coagulata* Gn. Edmonton, Alta., July, 1917, (D. Mackie).

4172. *Eupithecia niphadophilata* Dyar. Pocahontas, Alta., August, 1917, (K. Bowman).

4185. *Eupithecia scelestata* Tayl. Pocahontas, Alta., June, 1917, (K. Bowman).

4189. *Eupithecia alberta* Tayl. Nordegg, Alta., July, 1917, (K. Bowman).

4199. *Eupithecia terminata* Tayl. Pocahontas, Alta., June, 1917, (K. Bowman).

4274. *Eupithecia fumata* Tayl. Edmonton, Alta., May-June, 1916-1917, (D. Mackie).

* *Horisme vitalbata incana* Swett. Calgary, Alta., June 5, 1914; June 26, 1907; June 26, 1914, (Wolley-Dod); Psyche, XXIV, 190.

4291. *Dasyfidonia avuncularia* Gn. Blairmore, Alta., May, (K. Bowman).

4360a. *Phasiane respersata teucaria* Stkr. Victoria, B.C., May 28, 1918, (E. H. Blackmore).

4372. *Phasiane neptaria* Gn. Blairmore, Alta., May and Sept., (K. Bowman).

4372b. *Phasiane neptaria sinuata* Pack. Victoria, B.C., May 2, 1918, (E. H. Blackmore). This has been previously listed as *neptaria* Gn., but has been found to be conspecific with *sinuata* described by Packard from Vancouver Island. It occurs sparingly throughout the province, (E.H.B.).

* *Phasiane ponderosa* B. & McD. Cartwright, Man., June 14, July 24; Aweme, Man., June 20; Calgary, Alta., June 16; Cont. Lep. N.A., III, No. 4, 235.

* *Phasiane ponderosa demaculata* B. & McD. Calgary, Alta., May 11, July 1, 5; Banff, Alta., July 1; Field, B.C., July 2; Cont. Lep. N.A. III, No. 4, 235.

4421. *Itame bitactata* Wlk. Pocahontas, Alta., July, 1917, (K. Bowman).

4467. *Caripeta angustiorata* Wlk. Blairmore, Alta., July, (K. Bowman).

4565. *Cleora indicataria* Wlk. Edmonton, Alta., June-July, 1915-1917, (K. Bowman and D. Mackie).

4581. *Cleora emasculata* Dyar. Edmonton, Alta., June 1915-1917, (D. Mackie).

* *Cleora satisfacta* B. & McD. Kaslo, B.C., Aug. 15; Cont. Lep. N.A., III, No. 4, 244.

* *Aethaloptera anticaria fumata* B. & McD. Kaslo, B.C., April-May; Cont. Lep. N.A., III, No. 4, 244.

* *Xanthotype urticaria* Swett. "Nova Scotia"; Lepidopterist, fig. 6. pl. VII, Vol. II.

* *Xanthotype manitobensis* Swett. Aweme, Man., (N. Criddle); Lepidopterist, II, 78.

4602. *Glena cognataria* Hbn., McNab's Island, Halifax, N.S., June 14, 1910, (J. Perrin).

4608. *Lycia ursaria* Walk. Rossland, B.C., no date, (W. H. Danby). New to B.C.
* *Plagodis intermediaria* B. & McD. Ottawa, Ont., May 16, (C. H. Young); Cont. Lep. N.A., III, No. 4, 248.
4680. *Nematocampa limbata* Haw. Edmonton, Alta., Aug., 1917, (D. Mackie).
* *Metarranthis septentrionaria* B. & McD. Beulah, Man., June 21; Aweme, Man., May 29, June 18; Winnipeg, Man.; Cont. Lep. N.A., III, No. 4, 257.
4741. *Pero honestarius* Wlk. Edmonton, Alta., May-June, 1915-1917, (K. Bowman and D. Mackie).

Epiplemidæ.

4788. *Callizzia armorata* Pack. Edmonton, Alta., June-July, 1917, (K. Bowman and D. Mackie).

Pyralidæ.

* *Loxostege albertalis* B. & McD. Gleichen, Alta., July, (F. H. Wolley-Dod); Beulah and Miniota, Man.; Cont. Lep. N.A., Vol. IV, 2, 160.
5018. *Loxostege chortalis* Grt. Nordegg, Alta., July, 1917, (K. Bowman).
5093. *Phlyctaenia itysalis* Wlk. Pocahontas, Alta., Aug., 1917, (K. Bowman).
5099. *Phlyctaenia terrealis* Tr. Edmonton, Alta., June-July, 1917, (K. Bowman).
5140. *Pyrausta unifascialis* Pack. Nordegg, Alta., July, (K. Bowman).
5142. *Pyrausta fodinalis* Led. Edmonton, Alta., July, 1917, (K. Bowman).
5151. *Pyrausta borealis* Pack. Nordegg, Alta., July, 1917, (K. Bowman).
5154. *Pyrausta generosa* G. & R. Edmonton, Alta., July, 1917, (K. Bowman).
5155. *Pyrausta ochosalis* Dyar. Red Deer, Alta., June 1917, (K. Bowman).
5166. *Pyrausta nicalis* Grt. Edmonton, Alta., July, 1917, (K. Bowman).
5176. *Pyrausta funebris* Strom. Edmonton, Alta., Red Deer, Alta., June, 1916-1917, (D. Mackie and K. Bowman).
* *Pyrausta pythialis* B. & McD. Cartwright, Man., (E. F. Heath); Aweme, Man., June, (N. Criddle); Cont. Nat. Hist. Lep. N.A., Vol. IV, No. 2, p. 164.

Eucosmidæ.

7114. *Proteopteryx oregonana* Wlshm. Aweme, Man., (N. Criddle).
7129. *Proteopteryx ilicifoliana* Kearf. Vancouver, B.C., July 30, 1917, reared from holly, (R. C. Treherne).

Yponomeutidæ.

* *Swammerdamia cuprescens* Braun. Field, B.C.; Can. Ent., L, 231.

Gracilariidæ.

* *Ornix spiræifoliella* Braun. Field, B.C.; Can. Ent., L, 234.

Hepialidæ.

8486. *Hepialus hyperboreus* Moesch. Pocahontas, Alta., August, 1917, (K. Bowman). Exactly like the type (B. & McD.). *Hyperboreus* appeared in Dod's Alberta list and he so named the species for Mr. Mackie, but this, according to Sir George Hampson, is *H. mathewi* Hy. Edw. (K. B.).
8488. *Hepialus mathewi* Hy. Edw. Edmonton, Alta., Aug.-Sept., 1915-1916, (D. Mackie and K. Bowman).

Coleoptera.

(Arranged according to Henshaw's list of Coleoptera of America, North of Mexico.)

Cicindelidæ.

Cicindela unijuncta Csy. Edmonton, Alta., June 16, 1917, (F. S. Carr).

30. *Cicindela hyperborea* Lec. Edmonton, Alta., June 29, 1917, (F. S. Carr).

Carabidæ.

118. *Carabus chamissonis* Fisch. Edmonton, Alta., June 5, 1917; July 4, 1917, (F. S. Carr).

154. *Elaphrus obliteratus* Mann. Mile 332, Hudson Bay Ry., Man., July 14, 1917, (J. B. Wallis). New to Manitoba.

164. *Blethisa quadricollis* Hald. Husavick, Man., July 4, 1917, (L. H. D. Roberts). New to Manitoba.

172. *Opisthius richardsoni* Kirby. Edmonton, Alta., June 28, 1916, (F. S. Carr).

234. *Dyschirius terminatus* Lec. Edmonton, Alta., April 27, 1917, (F. S. Carr).

323. *Bembidium quadrulum* Lec. Mile 256, Hudson Bay Ry., Man., July 12, 1917, (J. B. Wallis). New to Manitoba.

325. *Bemdidium nigrum* Say. Winnipeg, Man., May 19, 1917. One specimen in my garden on Langside St., (J. B. Wallis). New to Manitoba.

339. *Bembidium nebraskense* Lec. Edmonton, Alta., March 29, 1918, (F. S. Carr).

343. *Bembidium transversale* Dej. Lake Dauphin, Man., March 27, 1918, (Mrs. W. W. Hippisley).

363. *Bembidium grapii* Gyll. Winnipeg, Man., April 9, 1909. This specimen has had a varied career. Prof. Wickham identified it as *dyschirinum*. Mr. Liebeck refused to commit himself. The present determination is Dr. Van Dyke's, (J. B. Wallis).

Bembidium constricticolli Haywd. Winnipeg, Man., April 24, 1916. Not quite typical, (J. B. Wallis). New to Manitoba.

373. *Bembidium obtusangulum* Lec. Leduc, Alta., May 11, 1914, (F. S. Carr).

397. *Bembidium dejectum* Csy. Winnipeg, Man., May 13, 1917. Also in my garden on Langside St., one only, (J. B. Wallis). New to Manitoba.

* *Bembidion brumale* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 22, issued Nov. 12, 1918.

* *Bembidion vacivum* Csy. Skeena River, B.C., (J. H. Keen): Memoirs on the Coleoptera, VIII, p. 22, issued Nov. 12, 1918.

* *Bembidion blanditum* Csy. Metlakatla, B.C., (J. H. Keen): Memoirs on the Coleoptera, VIII, p. 23, issued Nov. 12, 1918.

* *Bembidion impium* Csy. Agassiz, B.C. Memoirs on the Coleoptera, VIII, p. 28, issued Nov. 12, 1918.

* *Bembidion deceptor* Csy. Metlakatla, B.C., (J. H. Keen): Memoirs on the Coleoptera, VIII, p. 29, issued Nov. 12, 1918.

* *Bembidion nescium* Csy. Metlakatla, B.C., (J. H. Keen): Memoirs on the Coleoptera, VIII, p. 30, issued Nov. 12, 1918.

* *Bembidion viator* Csy. Massett, Q.C.I., B.C., (J. H. Keen): Memoirs on the Coleoptera, VIII, p. 31, issued Nov. 12, 1918.

* *Bembidion illex* Csy. Metlakatla, B.C., (J. H. Keen): Memoirs on the Coleoptera, VIII, p. 31, issued Nov. 12, 1918.

* *Bembidion haruspex* Csy. Inverness and Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 31, issued Nov, 12, 1918.

* *Bembidion bucolicum* Csy. Stikine River Canon, B.C., (H. F. Wickham); Memoirs on the Coleoptera, VIII, p. 34, issued Nov. 12, 1918.

* *Bembidion insopitans* Csy. Victoria, B.C., (H. F. Wickham); Memoirs on the Coleoptera, VIII, p. 68, issued Nov. 12, 1918.

* *Bembidion vancouveri* Csy. Victoria, B.C., (H. F. Wickham); Memoirs on the Coleoptera, VIII, p. 73, issued Nov. 12, 1918.

* *Bembidion imperitum* Csy. Victoria, B.C.; Memoirs on the Coleoptera, VIII, p. 91, issued Nov. 12, 1918.

* *Bembidion mobile* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 95, issued Nov. 12, 1918.

* *Bembidion imitator* Csy. Kamloops, B.C.; Memoirs on the Coleoptera, VIII, p. 105, issued Nov. 12, 1918.

* *Bembidion tolerans* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 132, issued Nov. 12, 1918.

* *Bembidion gregale* Csy. Agassiz, B.C.; Memoirs on the Coleoptera, VIII, p. 148, issued Nov. 12, 1918.

* *Bembidion peregrinum* Csy. Massett, Q.C.I., B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 159, issued Nov. 12, 1918.

* *Bembidion crassicornis* Csy. Inverness, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 165, issued Nov. 12, 1918.

* *Bembidion keeni* Csy. Metlakatla, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 166, issued Nov. 12, 1918.

Pogoninæ.

* *Patrobus labradorinus* Csy. W. St. Modest, Labrador, (Sherman); Memoirs on the Coleoptera, VIII, p. 395, issued Nov. 12, 1918.

* *Patrobus minuens* Csy. W. St. Modest, Labrador, (Sherman); Memoirs on the Coleoptera, VIII, p. 396, issued Nov. 12, 1918.

* *Patrobus laeviceps* Csy. W. St. Modest, Labrador, (Sherman); Memoirs on the Coleoptera, VIII, p. 396, issued Nov. 12, 1918.

* *Patrobus insularis* Csy. St. Paul Island, Alaska; Memoirs on the Coleoptera, VIII, p. 397, issued Nov. 12, 1918.

* *Trechus brumalis* Csy. W. St. Modest, Labrador, (Sherman); Memoirs on the Coleoptera, VIII, p. 408, issued Nov. 12, 1918.

Pterostichinæ.

* *Hypherpes innatus* Csy. "Canada (west of the Rocky Mountains)"; Memoirs on the Coleoptera, VIII, p. 329, issued Nov. 12, 1918.

* *Hypherpes responsor* Csy. Victoria, B.C., (H. F. Wickham); Memoirs on the Coleoptera, VIII, p. 330, issued Nov. 12, 1918.

* *Hypherpes anthrax* Csy. "Vancouver Island"; Memoirs on the Coleoptera, VIII, p. 331, issued Nov. 12, 1918.

* *Euferonia quadrifera* Csy. "Ontario"; Memoirs on the Coleoptera, VIII, p. 366, issued Nov. 12, 1918.

* *Cryobius otariidinus* Csy. St. Paul Island, Alaska; Memoirs on the Coleoptera, VIII, p. 374, issued Nov. 12, 1918.

* *Cryobius beringi* Csy. St. Paul Island, Alaska; Memoirs on the Coleoptera, VIII, p. 374, issued Nov. 12, 1918.

* *Cryobius delicatus* Csy. St. Paul Island, Alaska; Memoirs on the Coleoptera, VIII, p. 375, issued Nov. 12, 1918.

* *Cryobius breviusculus* Csy. St. Paul Island, Alaska; Memoirs on the Coleoptera, VIII, p. 375, issued Nov. 12, 1918.

Amarinæ.

* *Curtonotus labradorensis* Csy. Labrador, (W. St. Modest); Memoirs on the Coleoptera, VIII, p. 231, issued Nov. 12, 1918.

* *Curtonotus scrutatus* Csy. Labrador, (W. St. Modest); Memoirs on the Coleoptera, VIII, p. 231, issued Nov. 12, 1918.

* *Bradytus nainensis* Csy. Nain, Labrador, (Sherman); Memoirs on the Coleoptera, VIII, p. 238, issued Nov. 12, 1918.

* *Celia sinuosa* Csy. Aldermere, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 277, issued Nov. 12, 1918.

* *Amara keeni* Csy. Inverness, B.C., (J. H. Keen); Memoirs on the Coleoptera, VIII, p. 299, issued Nov. 12, 1918.

625. *Amara haematopa* Dej. Mile 214, Hudson Bay Ry., July 9, 1917; Mile 332, July 17, 1917, (J. B. Wallis). Previously recorded from Hudson Bay territory.

651. *Amara angustata* Say. Onah, Man., July 9th, 1916, (J. B. Wallis); Aweme, Man., July 10, 1917, (E. Criddle). Rare in Manitoba.

657. *Amara impuncticollis* Say. Miami, Man., July 2, 1914; Thornhill Man., June 30, 1916; Winnipeg, Man., June 8, 1917, (J. B. Wallis). Previously recorded by Dr. Bell from Oxford House.

658. *Amara littoralis* Mann. Victoria Beach, Man., June 17, 1916, (J. B. Wallis). New to Manitoba.

661. *Amara cupreolata* Putz. Winnipeg, Man., April 24, 1916; Calgary, Alta., April 7, 1915, (Tams). Previously mixed with *protensa*, of which species I have but one really typical specimen, from Aweme, (J. B. Wallis). New to Manitoba.

833. *Platynus gemellus* Lec. Aweme, Man., Oct. 16, 1917, (N. Criddle).

1107. *Harpalus laticeps* Lec. Aweme, Man., May 14, 1904, (N. Criddle).

Dytiscidæ.

1293. *Coelambus sellatus* Lec. Edmonton, Alta., April 9, 1916, (F. S. Carr).

1298. *Coelambus unguicularis* Cr. Edmonton, Alta., April 8, 1916, (F. S. Carr).

1300. *Coelambus fraternus* Lec. Edmonton, Alta., June 12, 1915, (F. S. Carr).

1349. *Hydroporus tartaricus* Lec. Edmonton, Alta., May 8, 1915, (F. S. Carr).

1355. *Hydroporus vitulus* Er. Edmonton, Alta., April 11, 1917, (F. S. Carr).

Gyrinidæ.

1472. *Colymbetes strigatus* Lec. Edmonton, Alta., May 5, 1917, (F. S. Carr).

1505. *Gyrinus minutus* Fab. Edmonton, Alta., Aug. 10, 1917, (F. S. Carr).

1507. *Gyrinus confinis* Lec. Le Pas, Man., June 30, 1917; Mile 214, Hudson Bay Ry., July 6, 1917, (J. B. Wallis). New to Manitoba.

1517. *Gyrinus maculiventris* Lec. Edmonton, Alta., June 12, 1915, (F. S. Carr).

1519. *Gyrinus affinis* Aube. Edmonton, Alta., May 5, 1917, (F. S. Carr).

1524. *Gyrinus pectoralis* Lec. Edmonton, Alta., Sept. 15, 1917, (F. S. Carr).

1525. *Gyrinus impressicollis* Kby. Mile 214, Hudson Bay Ry., Man., (J. B. Wallis). "I feel sure this is the long lost or never recognized *impressicollis* of Kirby, known only by the type in the British Museum." (H. C. Fall).

1528. *Gyrinus lugens* Lec. Mile 214, Hudson Bay Ry., Man., (J. B. Wallis). New to Manitoba.

Hydrophilidæ.

1630. *Philhydrus ochraceus* Mels. Mile 17, Hudson Bay Ry., July 2, 1917, (J. B. Wallis). New to Manitoba.

9335. *Cercyon tristis* Ill. Mile 214, Hudson Bay Ry., July 6, 1917, (J. B. Wallis). New to Manitoba.

Silphidæ.

1727. *Cholera alsiosa* Harv. Mile 214, Hudson Bay Ry., Man., July 10, 1917; under a dead mouse, (J. B. Wallis). New to Manitoba.

Cholera spenciana Kby. Mile 214, Hudson Bay Ry., Man., July 10, 1917; under a dead gopher, (J. B. Wallis). New to Manitoba.

1730. *Cholera clavicornis* Lec. Edmonton, Alta., Aug. 4, 1917, (F. S. Carr).

1732. *Cholera terminans* Lec. Mile 214, Hudson Bay Ry., Man., July 10, 1917; under a dead gopher, (J. B. Wallis). New to Manitoba.

Cholera horniana Blanch. Aweme, Man., July 17, 1918, (N. Criddle and J. B. Wallis). New to Manitoba.

1812. *Clambus gibbulus* Lec. Le Pas, Man., June 30, 1917, (J. B. Wallis). New to Manitoba.

Staphylinidæ.

Quedius aenescens Makl. Aweme, Man., April 22, 1918, (N. Criddle). New to Manitoba.

2011. *Atheta dichroa* Grav. Mile 332, Hudson Bay Ry., July 18, 1917, (J. B. Wallis). New to Manitoba.

Atheta remulsa Csy. Mile 214, Hudson Bay Ry., July 26, 1917, in fungus, (J. B. Wallis). New to Manitoba.

Atheta virginica Bernh. Mile 214, Hudson Bay Ry., July 10, 1917; Mile 332, Hudson Bay Ry., July 18, 1917, (J. B. Wallis). New to Manitoba.

Atheta fungi Groh. Peachland, B.C., Aug. 5, 1912; Winnipeg, Man., May 18, 1912; Miami, Man., June 27, 1916; on bracket fungus, (J. B. Wallis). New to Manitoba.

Atheta dentata Bernh. Onah, Man., July 9, 1916; Winnipeg, Man., Oct. 10, 1916, (J. B. Wallis). New to Manitoba.

Atheta graminicola Gr. Mile 17, Hudson Bay Ry., July 2, 1917, (J. B. Wallis). New to Manitoba.

Atheta irrita Csy. Mile 214, Hudson Bay Ry., July 24-26, 1917; in fungus, (J. B. Wallis). New to Manitoba.

2017. *Atheta recondita* Er. Mile 214, Hudson Bay Ry., July 10, 1917, (J. B. Wallis). New to Manitoba.

2022. *Amischa analis* Thom. Winnipeg, Man., May 10, 1912; April 24, 1916, (J. B. Wallis). New to Manitoba.

Paradilacra densissima Bernh. Winnipeg, Man., Sept. 23, 1916, (J. B. Wallis). New to Manitoba.

Metaxya awemeana Csy. Winnipeg, Man., Sept. 18, 1912; Miami, Man., June 26, 1916, (J. B. Wallis).

9562. *Dasyglossa prospera* Er. Winnipeg, Man., April 15, 1916; St. Norbert, Man., June 24, 1917, (J. B. Wallis). New to Manitoba.

Gymnusa variegata Kiesw. Bird's Hill, Man., May 5, 1917, (J. B. Wallis). New to Manitoba.

2165. *Philonthus basalis* Horn. Mile 332, Hudson Bay Ry., Man., July, 1918. One specimen now in the collection of Dr. H. C. Fall. (J. B. Wallis).

2234. *Philonthus aurulentus* Horn. Mile 214, Hudson Bay Ry., Man., July 6, 1917; Magnus, Man., Sept. 2, 1917, (J. B. Wallis). New to Manitoba.

2432. *Stenus fraternus* Csy. Mile 214, Hudson Bay Ry., Man., July 25, 26, 1917. (J. B. Wallis). New to Manitoba.

2447. *Stenus pollens* Csy. Mile 214, Hudson Bay Ry., Man., July 9-26, 1917, (J. B. Wallis). New to Manitoba.

2463. *Stenus punctatus* Er. Mile 214, Hudson Bay Ry., Man., July 26, 1917, with *pollens* and *fraternus*, (J. B. Wallis). New to Manitoba.

2634. *Tachyporus jocosus* Say. Le Pas, Man., June 30, 1917; Mile 214, Hudson Bay Ry., Man., July 6-26, 1917; Mile 332, Hudson Bay Ry., Man., July 13, 1917, not taken in Manitoba for a number of years, (J. B. Wallis).

2646. *Conosoma littoreum* Linn. Aweme, Man., Sept. 27, 1918, (N. Criddle).

2671. *Mycetoporus humidus* Say. Winnipeg, Man., April 24, 1916; Mile 214, Hudson Bay Ry., Man., July 6, 1917, (J. B. Wallis). New to Manitoba.

2675. *Mycetoporus flavicollis* Lec. Aweme, Man., July 18, 1918, (N. Criddle).

2833. *Olophrum latum* Mahl. Mile 17, Hudson Bay Ry., Man., July 2, 1917; Mile 214, July 24, 1917, (J. B. Wallis). "Said to be the same as *fuscum* Grav. An example of the latter from the Caucasus . . . . looks a little different." (H. C. Fall). New to Manitoba.

Coccinellidæ.

3053. *Hippodamia americana* Cr. Mile 17, Hudson Bay Ry., Man., July 2, 1917; one only in wash-up of lake, (J. B. Wallis).

3065a. *Coccinella abdominalis* Say. Winnipeg, Man., July 30, 1917, (L. H. Roberts). New to Manitoba.

3122. *Hyperaspis 4-vittata* Lec. Mile 17, Hudson Bay Ry., Man., July 2, 1917, (J. B. Wallis). New to Manitoba.

3156. *Scymnus tenebrosus* Muls. Darlingford, Man., May 28, 1916, (W. R. S. Metcalfe). Rare in Manitoba.

3160. *Stetharus* (*Scymnus*) *punctum* Lec. Aweme, Man., Sept. 9, 1918, (N. Criddle). New to Manitoba.

Colydiidæ.

3290. *Cerylon castaneum* Say. Edmonton, Alta., June 9, 1917, (F. S. Carr).

Cucujidæ.

3349. *Brontes dubius* Fab. Husavick, Man., July, 1914, (J. B. Wallis). New to Manitoba.

Histeridæ.

3486. *Hister foedatus* Lec. Aweme, Man., June 2, 1912; Onah, Man., July 14, 1918, (N. Criddle).

3488. *Hister punctifer* Payk. Edmonton, Alta., Sept. 4, 1915, (F. S. Carr).

3570. *Saprinus commonomus nodifer* Westn. Edmonton, Alta., April 2, 1915, (F. S. Carr).

Nitidulidæ.

3663. *Brachypterum globulosus* Mann. Edmonton, Alta., June 5, 1916, (F. S. Carr).

3737. *Meligethes sævus* Lec. Mile 214, Hudson Bay Ry., Man., July 6, 1917; on *Mertensia paniculata* var. *longisepala*. Occurred along the line of the Hudson Bay Ry., wherever its food plant grew, (J. B. Wallis). New to Manitoba; Edmonton, Alta., May 10, 1915, (F. S. Carr).

Nitidula nigra Schaef. Winnipeg, Man., April 23, 1916; Mile 214, Hudson Bay Ry., July 6, 1917, (J. B. Wallis). New to Manitoba.

3756. *Ips vittatus* Oliv. Lake Dauphin, Man., 1918, (Mrs. W. W. Hippisley).

Latridiidæ.

3798. *Corticaria serricollis* Lec. Mile 214, Hudson Bay Ry., July 26, 1917, (J. B. Wallis). New to Manitoba.

Byrrhidæ.

3890. *Byrrhus cyclophorus* Kirby. Edmonton, Alta., June 23, 1917, (F. S. Carr).

Elateridæ.

4101. *Cardiophorus edwardsii* Horn. Lillooet, B.C., (E. P. Venables).

4217. *Elater pedalis* Germ. Mile 214, June 6, 1917; Mile 332, Hudson Bay Ry., July 13, 1917, (J. B. Wallis). New to Manitoba.

4228. *Elater socer* Lec. Mile 17, Hudson Bay Ry., Man., July 2, 1917, (J. B. Wallis). New to Manitoba.

4257. *Drasterius debilis* Lec. Mile 214, Hudson Bay Ry., Man., July 6-13, 1917, (J. B. Wallis). New to Manitoba.

4414. *Paranomus costalis* Payk. Le Pas, Man., June 30, 1917; Mile 17, Hudson Bay Ry., July 2, 1917; Mile 214, Hudson Bay Ry., July 9, 1917; Mile 256, Hudson Bay Ry., July 12, 1917; Mile 332, Hudson Bay Ry., July 17, 1917, (J. B. Wallis). New to Manitoba.

Buprestidæ.

4628. *Anthraxia aeneogaster* Lap. Edmonton, Alta., June 27, 1917, (F. S. Carr).

4728. *Agrilus vittaticollis* Rand. Cawston, B.C., July 2, 1917, (W. R. Metcalfe).

4739. *Agrilus anxius* Gory. Cawston, B.C., June 21, 1917, (W. R. Metcalfe).

Lampyridæ.

4787. *Eros aurora* Hbst. Cawston, B.C., Aug. 5, 1917, (W. R. Metcalfe).

Ptinidæ.

* *Eucrada robusta* Van Dyke. Selkirk Mts., B.C., 1905, (J. C. Bradley); Bull. Brook. Ent. Soc., XIII, 6.

5337. *Endecatomus rugosus* Rand. Edmonton, Alta., June 6, 1916, (F. S. Carr).

Scarabæidæ.

5596. *Geotrupes splendidus* Fab. Ft. Coulonge, Que., June 1, 1918, (J. I. Beaulne). Addition to Quebec list.

5825. *Polyphylla variolosa* Hentz. Ft. Coulonge, Que., July 24, 1917, (J. I. Beaulne).

* *Cremastochilus bifoveatus* Van Dyke. Vernon, B.C., May, (W. H. Brittain); Bull. Brook. Ent. Soc., XIII, 14.

Spondylidæ.

5918. *Spondylis upiformis* Mann. Cawston, B.C., May 9, 1917, (W. R. Metcalfe).

Cerambycidæ.

5967. *Tragosoma harrisii* Lec. Nordegg, Alta., July 17, 1917, (K. Bowman).
5986. *Gonocallus collaris* Kirby. Edmonton, Alta., June 7, 1915, (F. S. Carr).
5988. *Physocnemum brevilineum* Say. Cartwright, Man., (E. F. Heath).
6010. *Callidium cicatricosum* Mann. Edmonton, Alta., April 8, 1916, (F. S. Carr).
6183c. *Xylotrechus undulatus fuscus* Kby. Le Pas, Man., July 3, 1917; Mile 214, Hudson Bay Ry., July 5-26, 1917; Mile 332, Hudson Bay Ry., July 16, 1917, (J. B. Wallis). New to Manitoba.
6184. *Xylotrechus annosus* Say. Cawston, B.C., June 24, 1917, (W. R. Metcalfe).
6267. *Acmaops longicornis* Kby. Cawston, B.C., May 20, June 30, 1917, (W. R. Metcalfe).
6332b. *Leptura cribripennis* Lec. Cawston, B.C., Aug. 5, 1917, (W. R. Metcalfe).
Leptura rufibasis Lec. Mile 17, Hudson Bay Ry., July 2, 1917; called a variety of *subargentata*, (J. B. Wallis). New to Manitoba.
6361. *Leptura mutabilis* Newm. Husavick, Man., July 12, 1917, (L. H. Roberts).
6363. *Leptura aspera* Lec. Winnipeg, Man., May, 1917; Mile 332, Hudson Bay Ry., July 17, 1917. The Mile 332 specimen is the testaceous form, (J. B. Wallis). New to Manitoba.
Pogonocherus salicola Csy. Husavick, Man., July, 1914, (J. B. Wallis). New to Manitoba.
6444. *Graphisurus pusillus* Kirby. Husavick, Man., July 11, 1917, (L. H. Roberts). New to Manitoba.

Chrysomelidæ.

Prasocuris ovalis Blatch. Husavick, Man., July 3, 1917, (L. H. Roberts); seems undoubtedly to be this species. New to Canada (?).
6891a. *Diabrotica fossata* Lec. Winnipeg, Man., Aug. 23, 1916, (J. B. Wallis). New to Manitoba.
6932. *Oedionychis vians* Ill. Ft. Coulonge, Que., June 1, 1918, (J. I. Beaulne). Addition to Quebec list.
6982. *Crepidodera modeeri* Linn. Husavick, Man., July 8, 1917, (L. H. Roberts); Onah, Man., July 9, 1918, (L. H. Roberts, N. Criddle, J. B. Wallis). Swept from herbage in swamp.
7032. *Mantura floridana* Cr. Edmonton, Alta., Aug. 9, 1917, (F. S. Carr).

Bruchidæ.

7159. *Bruchus macrocerus* Horn. Edmonton, Alta., July 13, 1918, (F. S. Carr).

Tenebrionidæ.

7226a. *Phellopsis porcata* Lec. Lillooet, B.C., (E. P. Venables).
7488. *Anaedus brunneus* Ziegl. Husavick, Man., July 12, 1915, (J. B. Wallis). New to Manitoba.
7542. *Boletophagus depressus* Rand. Dauphin, Man., (Mrs. W. W. Hippisley). New to Manitoba.

Cistelidæ.

7626. *Mycetochares basillaris* Say. Miami, Man., July 6, 1914, (J. B. Wallis). New to Manitoba.

Melandryidæ.

7665. *Enchodes sericea* Hald. Dauphin, Man., 1918, (Mrs. W. W. Hippisley).

Pythidæ.

7707. *Crymodes discicollis* Lec. Vernon, B.C., (E. P. Venables).

Mordellidæ.

7766. *Anaspis atra* Lec. Mile 332, Hudson Bay Ry., July 17, 1917, (J. B. Wallis). *Atra* by Smith's table; locality suggests *nigra* (H. C. F.). New to Manitoba.

7778. *Mordella borealis* Lec. Mile 214, Hudson Bay Ry., Man., July 21-26, 1917; on orange-coloured fungous growth on spruce log, (J. B. Wallis). New to Manitoba.

7785. *Mordella serval* Say. Aweme, Man., July 24, 1903, (N. Criddle). New to Manitoba.

7795. *Mordellistena bicinctella* Lec. Aweme, Man., July 20, 1917, (N. Criddle). New to Manitoba.

7805. *Mordellistena vilis* Lec. Aweme, Man., June 19, 1917, (N. Criddle). New to Manitoba.

Mordellistena frosti Lilj. Aweme, Man., July 3, 1917, (N. Criddle). New to Canada.

7807. *Mordellistena decorella* Lec. Aweme, Man., July 7, 1911, (N. Criddle). New to Manitoba.

7819. *Mordellistena tosta* Lec. Aweme, Man., Aug. 2, 1917, (N. Criddle). New to Manitoba.

7833. *Mordellistena nigricans* Melsh. Aweme, Man., Aug. 10, 1917, (N. Criddle).

7840. *Mordellistena convicta* Lec. Aweme, Man., June 19, 1917, (N. Criddle). New to Manitoba.

7843. *Mordellistena morula* Lec. Aweme, Man., July 9, 1917, (E. Criddle). New to Manitoba.

Mordellistena divisa Lec. Aweme, Man., July 29, 1917, (N. Criddle). New to Manitoba.

7858. *Mordellistena æthiops* Smith. Aweme, Man., July 3, 1917, (N. Criddle). New to Manitoba.

Anthicidæ.

7918. *Notoxus talpa* Laf. Onah, Man., July 9, 1918, (Wallis, Roberts, Criddle); Aweme, Man., Aug., (J. Fletcher). New to Manitoba.

Anthicus hastatus Csy. Thornhill, Man., Aug. 19, 1917, (J. B. Wallis). "Does not agree with type in colour," (H. C. F.). New to Manitoba.

Meloidæ.

8103. *Epicauta corvinus* Lec. Husavick, Man., (E. Coates). New to Manitoba.

Rhynchitidæ.

8203. *Auletes congruus* Wlk. Mile 332, Hudson Bay Ry., July 17, 1917, (J. B. Wallis). New to Manitoba.

Otiorhynchidæ.

8245. *Ophryastes sulcirostris* Say. Boissevain, Man., Sept. 20, 1917, (N. Criddle).

Curculionidæ.

8367. *Apion punctinassum* Sm. Miami, Man., July 5, 1916; Onah, Man., July 9, 1916, (J. B. Wallis). New to Manitoba.

Apion nebraskense. Stony Mountain, Man., July 31, 1916, (J. B. Wallis). New to Manitoba.

8177. *Pissodes rotundatus* Lec. Grand Marais, Man., July 26, 1916, (J. B. Wallis). New to Manitoba.

10885. *Dorytomus vagenotatus* Csy. Winnipeg, Man., April 3-15, 1916, (J. B. Wallis); Darlingford, Man., April 23, June 4, 1916, (W. R. Metcalfe). New to Manitoba.

8571. *Endalus limatulus* Gyll. Winnipeg, Man., July 20, 1916, (J. B. Wallis). New to Manitoba.

8576. *Tanysphyrus lemnæ* Fab. Miami, Man., June 27, 1916, (J. B. Wallis). New to Manitoba.

8637. *Anthonomus scutellatus* Gyll. Winnipeg, Man., Aug. 2, 1916, (J. B. Wallis). Rare in Manitoba.

11006. *Anthonomus squamulatus* Dietz. Onah, Man., July 9, 1916, (J. B. Wallis.

11018. *Pseudanthonomus validus* Dietz. Husavick, Man., Aug., 1913, (J. B. Wallis). New to Manitoba.

8675. *Orchestes minutus* Horn. Onah, Man., July 9, 1918, (N. Criddle). New to Manitoba.

8676. *Orchestes rufipes* Lec. Mile 332, Hudson Bay Ry., July 13, 1917, (J. B. Wallis). New to Manitoba.

11079. *Phytobius griseomicans* Dtz. Miami, Man., July 5, 1916; Grand Marais, Man., July 26, 1916; Stony Mountain, Man., July 31, 1916; Le Pas, Man., June 30, 1917; Mile 17, Hudson Bay Ry., July 2, 1917; Mile 214, Hudson Bay Ry., July 6, 1917; Mile 256, Hudson Bay Ry., July 12, 1917, (J. B. Wallis). Probably equals European *velatus*. (H. C. F.). New to Manitoba.

Ceutorhynchus neglectus Blatchley. Edmonton, Alta., June 28, 1915, (F. S. Carr).

8727. *Conotrachelus posticatus* Boh. Thornhill, Man., July 1, 1916, (J. B. Wallis). New to Manitoba.

8735. *Conotrachelus anaglypticus* Say. Miami, Man., June 28, 1916, (J. B. Wallis). New to Manitoba.

Calandridæ.

Sphenophorus zeæ. Winnipeg, Man., July 1, 1916, (J. B. Wallis). New to Manitoba.

9044. *Rhyncholus brunneus* Mann. Onah, Man., July 9, 1918, (N. Criddle).

Ipidæ.

* *Lesperisinus criddlei* Sw. Aweme, Man., (N. Criddle): St. Hilaire, Que.: Bull. 14, pt. 2, p. 72, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

* *Cryphalus canadensis* Chamberlain. Roger's Pass, B.C., Sept. 28, 1915, (J. M. Swaine); Bull. 14, pt. 2, p. 88, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

* *Pityophthorus pseudotsugæ* Sw. Vernon, B.C., June 29, 1914, (J. M. Swaine); Bull. 14, pt. 2, p. 99, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

* *Pityogenes knechteli* Sw. Jasper Park, Alta., Aug. 30, 1915, (J. M. Swaine); Nechako Valley, B.C., Atlin, B.C., Bull. 14, pt. 2, p. 106, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

* *Ips laticollis* Sw. Near Ottawa, Ont., Bull. 14, pt. 2, p. 116, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

* *Ips dubius* Sw. Roger's Pass, B.C., Sept. 28, 1915, (J. M. Swaine); Selkirks and Rockies, between Glacier, B.C., and Banff, Alta.; Bull. 14, pt. 2, p. 119, Ent. Br., Dom. Dept. Agr., issued Sept. 6, 1918.

DIPTERA.

(Arranged according to a Catalogue of North American Diptera, by J. M. Aldrich. Smithsonian Misc. Coll. XLVI. No. 1,444. The numbers refer to the pages in the catalogue.)

Tipulidæ.

* *Pachyrhina perdita* Dietz. Aweme. Man., Aug. 7, 1913, (E. Criddle); Trans. Amer. Ent. Soc., XLIV, 116.

* *Pachyrhina opacivittata* Dietz. Aweme. Man., (E. Criddle); Trans. Amer. Ent. Soc., XLIV, 123.

* *Pachyrhina festina* Dietz. Ridgeway, Ont., Aug. 15, 1910, (M. C. Van Duzee); Aweme, Man., (E. Criddle); Trans. Amer. Ent. Soc., XLIV, 126.

* *Pachyrhina obliterata* Dietz. Ottawa, Ont., July 26, 1912, (G. Beaulieu); Trans. Amer. Ent. Soc., XLIV, 133.

* *Tipula macrolaboides* Alex. "Hudson Bay Territory;" Can. Ent., L, 69.

Chironomidæ.

108. *Johannseniomyia (Ceratopogon) albaria* Coq. St. Louis, Que., Aug. 15, 1918, (J. Ouellet). Addition to Quebec list.

110. *Palpomyia (Ceratopogon) subasper* Coq. St. Louis Que., Aug. 8, 17, 19, 1918, (J. Ouellet). Addition to Quebec list.

Mycetophilidæ.

Leia opima Lw. Outremont, Que., Aug. 25, (J. Ouellet). New to Canada, (J. M. A.).

* *Neosciara lobosa* Pettey. Carbonate, Columbia River, B.C., July 7-12, 1908, (J. C. Bradley); An. Ent. Soc. Amer., XI, 333.

* *Neosciara ovata* Pettey. Howser, Selkirk Mountains, B.C., June 22, 1905, (J. C. Bradley); An. Ent. Soc. Amer., XI, 336.

Bibionidæ.

166. *Bibio nervosus* Lw. Outremont, Que., May 15, 1917, (J. Ouellet). Addition to Quebec list.

166. *Bibio xanthopus* Wied. Montreal, Que., May 21, 1918, (A. F. Winn). Addition to Quebec list.

167. *Dilophus obesulus* Lw. Outremont, Que., June 7, 1917; St. Louis, Que., July 8, 1918, (J. Ouellet). Addition to Quebec list.

167. *Dilophus tibialis* Lw. St. Louis, Que., Aug. 8, 1918, (J. Ouellet). Addition to Quebec list.

Tabanidæ.

197. *Chrysops macchus* O. S. Joliette, Que., July 15, 1917, (J. Ouellet). Addition to Quebec list.

198. *Chrysops striatus* O. S. St. Louis, Que., Aug. 3, 9, 1918, (J. Ouellet). Addition to Quebec list.

198. *Chrysops univittatus* Macq. Joliette, Que., July 6, 22, 1918, (J. Ouellet). Addition to Quebec list.

Therevidæ.

247. *Psilocephala notata* Wied. Coniston, Ont., July 26, 1915, (H. S. Parish). Mr. J. Ouellet has also taken the species in Quebec Province. Addition to Quebec list.

247. *Psilocephala nigra* Say. Montreal, Que., Aug. 25, 1917; St. Louis, Que., Aug. 3, 1918, (J. Ouellet). Addition to Quebec list.

Mydaidæ.

251. *Mydas clavatus* Dr. Longwood, Ont., July 4, 1918, (G. Blair).

Asilidæ.

Asilus erythrocnemius Hine. Montreal, Que., Aug. 28, 1917; Joliette, Que., Aug. 15, 1917; St. Louis, Que., Aug. 3, 1918, (J. Ouellet). Addition to Quebec list.

283. *Asilus paropus* Walk. St. Louis, Que., Aug. 6, 1918, (J. Ouellet). Addition to Quebec list.

Dolichopodidæ.

297. *Hydrophorus chrysologus* Walk. St. Louis, Que., Aug. 6, 20, 1918, (J. Ouellet). Addition to Quebec list.

Empidæ.

* *Drapetis aliternigra* Mel. "British Columbia;" An. Ent. Soc. Amer., XI, 192.

* *Drapetis infumata* Mel. Nelson, B.C., July 17, 1910; An. Ent. Soc. Amer., XI, 194.

* *Drapetis setulosa* Mel. "British Columbia;" An. Ent. Soc. Amer., XI, 196.

* *Endrapetis facialis* Mel. Medicine Hat, Alta., (J. R. Malloch); An. Ent. Soc. Amer., XI, 200.

Microsania imperfecta Lw. Aweme, Man., Sept. 18, 1915, (N. Criddle).

317. *Syneches pusillus* Lw. Terrebonne, Que., Aug. 20, 1918; St. Louis, Que., Aug. 13, 1918, (J. Ouellet). Addition to Quebec list.

331. *Rhamphomyia irregularis* Lw. Outremont, Que., May 19, 1917, (J. Ouellet). Addition to Quebec list.

Phoridæ.

Aphiochæta evarthæ Mall. Strathroy, Ont., Aug. 14, 1918, (H. F. Hudson).

Syrphidæ.

Pipiza festiva Mg. Mount Royal, Que., May 21, June 2, 1918, (J. Ouellet).

350. *Pipiza pisticoides* Will. Mount Royal, Que., May 23, June 2, 1918, (J. Ouellet). Addition to Quebec list.

363. *Didea laxa* O. S. Outremont, Que., Sept. 19, 1918, (J. Ouellet). Addition to Quebec list.

Syrphus perplexus Osb. Outremont, Que., June 5, Sept. 1, 1918, (J. Ouellet); Rawdon, Que., Aug. 12, 1917. Addition to Quebec list.

377. *Volucella bombylans americana* Jns. Montreal, Que., June 28, 1917, (J. Ouellet). Addition to Quebec list.

393. *Helophilus hamatus* Lw. St. Louis, Que., Aug. 16, 1918, (J. Ouellet). Addition to Quebec list.

393. *Helophilus laetus* Lw. Outremont, Que., June 5, 1917; St. Louis, Que., Aug. 16, 1918, (J. Ouellet). Addition to Quebec list.

399. *Xylota fraudulosa* Lw. Outremont, Que., May 15, June 2, 1918, (J. Ouellet). Addition to Quebec list.

Conopidæ.

412. *Oncomyia modesta* Will. St. Louis, Que., Aug. 15, 1918, (J. Ouellet). Addition to Quebec list.

Tachinidæ.

Viviania lachnosternæ Tns. St. Remi, Que., June 24, 1918, (J. Ouellet). New to Canada, (J. M. A.).

(*Imitomyia*) *Himantostoma sugens* Lw. According to Aldrich *Saskatchewania canadensis*, records of which occur in the Ent. Record for 1915, is evidently the long lost *H. sugens.*

433. *Hypostena barbata* Coq. St. Louis, Que., Aug. 3, 1918, (J. Ouellet). Addition to Quebec list.

440. *Eutrixa exilis* Coq. Outremont, Que., May 19, 1917, (J. Ouellet). Addition to Quebec list.

441. *Xanthomelana flavipes* Coq. Terrebonne, Que., Aug. 19, (J. Ouellet). New to Canada, (J. M. A.).

445. *Metaplagia occidentalis* Coq. Joliette, Que., July 10, 1917, (J. Ouellet). Addition to Quebec list.

Panzeria ampelos Walk. Outremont, Que., May 20, 1917; Sept. 19, 1918; Joliette, Que., July 5, 24, 1918; St. Louis, Que., Aug. 7, 1918, (J. Ouellet). Addition to Quebec list.

Exorista caesar Ald. "I lately got some material for determination which almost convinced me that my *Exorista caesar,* a Canadian fly, is a synonym of *nigripalpis* Tns. The point of difference was the existence of one, or several bristles on the outer front side of the middle tibia: I now think this is sometimes variable, though usually constant." (J. M. A.).

461. *Phorocera erecta* Coq. Mount Royal, Que., May 23, 1918, (J. Ouellet). New to Canada, (J.M.A.).

470. *Tachina robusta* Tns. Newaygo, Argenteuil Co., Que., June 17, 1917, (A. F. Winn). No definite Quebec record in Quebec list.

475. *Phorichaeta sequax* Will. Outremont, Que., July 29, 1917, Sept. 16, Oct. 1, 1918; St. Louis, Que., July 30, 1918, (J. Ouellet). No Quebec records in Quebec list.

488. *Echinomyia decisa* Wlk. Cap a l'Aigle, Que., Aug. 3-17, 1918, (A.F. Winn); Mount Royal, Que., June 15, 1918, (J. Ouellet). Addition to Quebec list.

Dexiidæ.

Thelairodes clemonsi Tns. St. Remi, Que., June 25, (J. Ouellet). New to Canada, (J.M.A.).

Sarcophagidæ.

Sarcophaga latisterna Pk. Outremont, Que., May 20, June 23, Aug. 22, 1918, (J. Ouellet). Addition to Quebec list.

Sarcophaga cooleyi Pk. Allan, Sask., Aug. 11, 1917, (A. E. Cameron).

Sarcophaga marginata Ald. Outremont, Que., Sept. 13, 1918, (J. Ouellet). Addition to Quebec list.

* *Sarcophaga vancouverensis* Pk. Vancouver, B.C., May 12, 19, 1916; June 11, 1916; Savory Island, July 3, 1916; Bd. Bay, May 22, 1915, (R. S. Sherman). Can. Ent., L. 123.

Muscidæ.

Phormia azurea Fall. Outremont, Que., July 28, 1917, (J. Ouellet). Addition to Quebec list.

525. *Pyrellia cyanicolor* Zett. Outremont, Que., May 21, 23, 1917, (J. Ouellet). Addition to Quebec list.

Anthomyidæ.

Hydrotaa houghi Mall. Outremont, Que., Sept. 21, 1917, (J. Ouellet). Addition to Quebec list.

* *Pogonomyia minor* Mall. Farewell Creek, Sask.; Trans. Amer. Ent. Soc., XLIV, 280.

544. *Mydaa duplicata* Mg. Outremont, Que., May 15, Aug. 25, 1917, (J. Ouellet). Addition to Quebec list.

545. *Spilogaster signia* Wlk. Montreal, Que., Oct. 14, 1918, (A. F. Winn). Addition to Quebec list.

Limnophora brunneisquama Mall. St. Remi, Que., June 25, 1918, (J. Ouellet). Addition to Quebec list.

* *Fannia spathiophora* Mall. Gold Rock, Rainy River District, Ont., July 21, 1905, (H. H. Newcombe); Trans. Amer. Ent. Soc., XLIV, 294.

546. *Mydaa uniseta* Stein. Outremont, Que., June 11, Sept. 18, 1918, (J. Ouellet). Addition to Quebec list.

Mydæa rufitibia Stein. Outremont, Que., May 15, 1917, (J. Ouellet). Addition to Quebec list.

Mydaa nitida Stein. Outremont, Que., May 28, (J. Ouellet). Addition to Quebec list. (=*nigripennis* Walk. J.M.A.).

548. *Anthomyia albicincta* Fall. St. Louis, Que., Aug. 15, 1918, (J. Ouellet). Addition to Quebec list.

Hylemyia coenosiæformis St. St. Louis, Que., July 30, Aug. 15, 1918, (J. Ouellet). Addition to Quebec list.

* *Hylemyia pluvialis* Mall. Gold Rock, Ont., July 21, (H. H. Newcombe); Can. Ent. L, 310.

Hylemyia tenax Johannsen. Joliette, Que., July 10, 1918, (J. Ouellet). Addition to Quebec list.

558. *Pegomyia affinis* Stein. St. Louis, Que., Aug. 8, 1918, (J. Ouellet). Addition to Quebec list.

* *Fucellia æstuum* Ald. Vancouver, B.C., Aug. 8, 1917, (Melander); Pender Island, B.C., (Aldrich); Proc. Cal. Acad. Sci., VIII, 157-179.

Cœnosia humilis Mg. Outremont, Que., Sept. 13, 20, 1918, (J. Ouellet). Addition to Quebec list.

561. *Cœnosia hypopygialis* St. St. Remi, Que., June 25, 1918, (J. Ouellet). New to Canada, (J.M.A.).

Lispocephala alma Mg. Mount Royal, Que., April 16, (J. Ouellet). Addition to Quebec list.

Scatophagidæ.

565. *Cordylura latifrons* Lw. St. Louis, Que., Aug. 14, 17, 1918, (J. Ouellet). New to Canada, (J.M.A.).

567. *Hydromyza confluens* Lw. Brome Lake, Que., Aug. 1, 1917, (A. F. Winn). Addition to Quebec list.

567. *Opsiomyia palpalis* Coq. St. Louis, Que., Aug. 16, 1918 (J. Ouellet). New to Canada, (J.M.A.).

Heteroneuridæ.

Clusia czernyi Johnson. Outremont, Que., May 31, 1917, June 15, 20, 1918, (J. Ouellet). Addition to Quebec list.

Helomyzidæ.

Helomyza plumata Lw. Mount Royal, Que., June 15, 1917, (J. Ouellet). Addition to Quebec list.

Leria serrata L. Outremont, Que., May 6, 18, 1917, (J. Ouellet). Addition to Quebec list.

Borboridæ.

Borborus marmoratus Becker. St. Louis, Que., Aug. 13, 1918, (J. Ouellet). Addition to Quebec list.

Sciomyzidæ.

579. *Tetanocera lineata* Day. Mount Royal, Que., Sept. 20, 1917; St. Louis, Que., Aug. 7, 19, 1918, (J. Ouellet). Addition to Quebec list.

Sapromyzidæ.

Sapromyza similata Mall. Mount Royal, Que., June 13, 1917, Aug. 11, 1917, (J. Ouellet). New to Canada, (J.M.A.).

Trypetidæ.

603. *Acidia fratria* Lw. Montreal, Que., June 23, 1917, (J. Ouellet).

Rhagoletis fausta O. S. =*intrudens* Ald. Aweme, Man., reared from fruit of *Prunus pennsylvanica*, (N. Criddle).

Micropezidæ.

617. *Calobata pallipes* Say. St. Louis, Que., July 30, 1918, (J. Ouellet). Addition to Quebec list.

Sepsidæ.

Sepsis signifera curvitibia M. & S. Outremont, Que., Sept. 21, 1917, (J. Ouellet). Addition to Quebec list.

Piophila oriens Mel. Outremont, Que., May 16, 1918, (J. Ouellet). New to Canada, (J.M.A.).

Piophila pusilla Mg. Outremont, Que., Sept. 23, 1918, (J. Ouellet). Addition to Quebec list.

Psilidæ.

621. *Chyliza notata* Lw. Montreal, Que., May 23, 1917, (J. Ouellet). Addition to Quebec list.

Ephydridæ.

Hyadina nitida Macq. Aweme, Man., July 19, 1916, (N. Criddle). An European species, new to Canada.

629. *Parydra limpidipennis* Lw. St. Louis, Que., Aug. 7, 19, 1918, (J. Ouellet). New to Canada, (J.M.A.).

630. *Scatella oscitans* Wlk. Outremont, Que., June 17, 1917, Sept. 23, 1917; St. Louis, Que., Aug. 14, 1918; St. Remi, Que., June 28, 1918, (J. Ouellet). Addition to Quebec list.

Atissa pygmæa Haliday. Aweme. Man., (N. Criddle). An European species, new to Canada.

Oscinidæ.

633. *Chlorops crocota* Lw. Aweme, Man., Aug. 11, 1917, (N. Criddle).

634. *Chlorops rubicunda* Adams. Aweme, Man., (N. Criddle).

Elachiptera melampus Lw. Aweme, Man., (N. Criddle).

Elachiptera nigriceps Lw. Outremont, Que., Sept. 22, 1917, (J. Ouellet). Addition to Quebec list.

Siphonella finalis Beck. Aweme, Man., (N. Criddle).

* *Dicræus incongruus* Ald. Treesbank. Man., (N. Criddle): Can. Ent. L. 340

Oscinis anthracina Lw. Aweme, Man., (N. Criddle).

Osinis incerta Beck. Aweme, Man., (N. Criddle).

Oscinis frontalis Tucker. Aweme, Man., (N. Criddle).

* *Oscinis criddlei* Ald. Treesbank and Aweme, Man., (N. Criddle): Can. Ent. L, 341.

* *Oscinis scabra* Ald. Treesbank, Man., May 6, 1916; Aweme, Man., Sept. 12, Oct. 13, 1916: Estevan, Sask., May 20, 1916, (N. Criddle): Can. Ent. L, 342.

Oscinis frit L. Outremont, Que., (J. Ouellet). Addition to Quebec list.

* *Lasiosina canadensis* Ald. Ogema, Sask.; Estevan, Sask.; Treesbank, Man.; Aweme, Man., (N. Criddle); Can. Ent. L, 337.

Lasiosina similis Mall. Aweme, Man., (N. Criddle).

Geomyzidæ.

Chyromya femorella Fall. Outremont, Que., (J. Ouellet). An European species, new to Canada.

Agromyzidæ.

Agromyza pusilla Mg. St. Louis, Que., Aug. 14, 1918, (J. Ouellet). Addition to Quebec list.

Agromyza posticata Mg. Mount Royal, Que., Sept. 10, 22, 1917; Outremont Que., May 28, 1917, (J. Ouellet). Addition to Quebec list.

Agromyza coquilletti Mall. St. Louis, Que., July 30, 1918; Aug. 13, 1918, (J. Ouellet). Addition to Quebec list.

Agromyza laterella Zett. Terrebonne, Que., Aug. 20, 1918, (J. Ouellet). Addition to Quebec list.

Agromyza vibrissata Mall. Outremont, Quebec., Sept. 19, 1917, (J. Ouellet). Addition to Quebec list.

648. *Agromyza parvicornis* Lw. Outremont, Que., Sept. 8, 1917, (J. Ouellet). Addition to Quebec list.

Desmometopa latipes Mg. Aweme, Man., (N. Criddle).

Hymenoptera.

Vipionidæ.

Opius fuscipennis Gahn. Aweme, Man., July 1, 1918; reared from *Rhagoletis fausta* O. S., (N. Criddle).

Braconidæ.

* *Microbracon cephi* Gahan. Treesbank, Man.; reared from *Cephus cinctus* in stems of *Elymus canadensis*, (N. Criddle). Proc. Ent. Soc. Wash. XX, 19.

Serphidæ.

Serphus caudatus Say. Aweme, Man., Aug. 28, 1915, (N. Criddle).

Formicidæ.

Formica bradleyi Wheeler. Aweme, Man., May 30, 1916, (N. Criddle).

Camponotus abdominalis stercorarius Forel. Lillooet, B.C., found on imported bananas probably from Central or South America; determined by W. M. Wheeler, (A. W. A. Phair).

Audrenidæ.

* *Andrena columbiana* Vier. Mission, B.C., Aug. 8, 1904, (R. V. Harvey); Trans. Amer. Ent. Soc., XLIII, 374.

* *Andrena persimulata* Vier. Montreal Island, Que.; Trans. Amer. Ent. Soc., XLIII, 390.

Apidæ.

Diadasia australis Cr. Lethbridge, Alta., June 28, 1914, on *Opuntia*, (F. W. L. Sladen).

Diadasia diminuta Cr. Salmon Arm, Vernon, B.C., on mallow, (F. W. L. Sladen).

Hemiptera.

(Arranged according to a Catalogue of the Hemiptera of America, North of Mexico—excepting the Aphididæ, Coccidæ and Aleurodidæ; by E. P. Van Duzee; University of California Publications, 1917.)

Aphididæ.

* *Symydobius americanus* Baker. Puslinch Lake, near Guelph, Ont., 1909, (A. C. Baker); Can. Ent. L, 318.

Pentatomidæ.

184. *Banasa calva* Say. Jordan, Ont., May 11, 1918, (W. A. Ross).

Coreidæ.

247. *Leptoglossus occidentalis* Heid. Jordan, Ont., June 30, 1917, (W. A. Ross).

348. *Corizus lateralis* Say. Jordan, Ont., Sept. 9, 1918, (W. A. Ross).

Lygaeidæ.

* *Peritrechus saskatchewanensis* Barber. Oxbow, Sask., (F. Knab): Jour. N.Y. Ent. Soc. XXVI, 60

Tingididæ.

639. *Corythucha arcuata* Say. Aweme, Man., June 14, 1918, on *Quercus macrocarpus*, (N. Criddle).

640. *Corythucha pergandei* Heid. Halifax, N.S., 1897, (W. H. Harrington).
Corythucha cydoniae Fitch. Aweme, Man., Aug. 9, 1918, (N. Criddle): on *Cratægus* and *Amalanchier spicata.*
Corythucha immaculata O. & D. Lillooet, B.C., (A. W. A. Phair).
Corythucha heidemanni Drake. Ottawa, Ont., (W. H. Harrington).
Corythucha hewitti Drake. Aweme, Man., July 9, 1918, on *Corylus americana,* (N. Criddle).
Corythucha salicis O. & D. Trenton, Ont., Sept. 1, 1910, (J. D. Evans): Aweme, Man., Aug. 13, 1918, on *Salix discolor,* (N. Criddle).
Corythucha elegans Drake. Hastings Co., Ont., July 27, 1903, (J. D. Evans); Ottawa, Ont., Oct. 13, 1908, on poplar, (H. Groh).
Corythucha betulæ Drake. Ottawa, Ont., (W. H. Harrington).

Anthocoridæ.

847. *Xylocoris sordidus* Reut. Bowmanville, Ont., Aug. 19, 1913, (W. A. Ross).

Miridæ.

1019. *Lygus hirticulus* Van D. Jordan, Ont., July 9, 1915, (W. A. Ross).

Cicadellidæ.

* *Erythroneura ador* McAtee. Halifax, N.S., Aug. 5, 1917, Sept. 1, 1917; Can. Ent., L, 361.
* *Typhlocyba cimba* McAtee. Halifax, N.S., Sept. 1, 1917; Can. Ent., L, 360.

ODONATA.

(Arranged according to Muttkowski's Catalogue of the Odonata of North America. The numbers refer to the pages in the catalogue).

Coenagrionidæ.

54. *Enallagma antennatum* Say. Ironside, Que., (L. M. Stöhr).
60. *Enallagma hageni* Walsh. Red Deer, Alta., June 23, 1918; new to Alberta list, (F. C. Whitehouse).
65. *Nehalennia posita* Hagen. Ironside, Que., (L. M. Stöhr).
67. *Chromagrion conditum* Hagen. Ironside, Que., (L. M. Stöhr).

Aeshnidæ.

82. *Hagenius brevistylus* Selys. Ironside, Que., (L. M. Stöhr). First definite record from Quebec province, (E.M.W.).
83. *Ophiogomphus anomalus* Harvey. Ironside, Que., (L. M. Stöhr). Not previously recorded from Canada: I have, however, seen specimens from L. Nipigon, Ont., (E.M.W.).
97. *Gomphus spicatus* Hagen. Ironside, Que., (L. M. Stöhr). First record from Quebec province, (E.M.W.).
77. *Cordulegaster obliquus* Say. Ironside, Que., (L. M. Stöhr). First undoubted record from Quebec province, Provancher's specimens being of uncertain identity, (E.M.W.).

Libellulidæ.

* *Somatochlora kennedyi* E. M. Walk. Mer Bleue, near Ottawa, June 9, 1903, (A. Gibson): Godbout River, Que., July 29, 1918, (Walker): De Grassi Point, Ont., June 19, 1917, (Walker); Can. Ent., L, 371.

138. *Libellula luctuosa* Burm. Ironside, Que., (L. M. Stöhr). New to Quebec province.

PLECOPTERA.

* *Protarcys bradleyi* Smith. Lake Louise, Alta., June 25, 1908; Rogers Pass, B.C. Aug. 7, 1908; Ground Hog Basin, Selkirk Mtns., B.C., July 22—Aug. 7, 1905, (J. C. Bradley); Trans. Amer. Ent. Soc., XLIII, 470.

COLLEMBOLA.

Mr. Charles Macnamara, of Arnprior, Ont. has continued his studies of these insects, and during 1918 he has collected the following around Arnprior. These have not been previously noted.

* *Isotoma macnamarai* Folsom; Can. Ent., L, 291.
Seira buskii Lubbock.
Papirius maculosus Schott.
Sminthurus aquaticus Bourlet.
Sminthurus quadrimaculatus Ryder.
Sminthurus malmgreni elegantulus Reuter.

In addition to the above it is of interest to record *Achorutes harveyi* Folsom, from Aweme, Man., (N. Criddle). In the same locality the same collector has found *Isotoma viridis riparia* Nicolet.

INDEX

Ontario Department of Agriculture

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THE RYERSON PRESS

To His Honour, LIONEL H. CLARKE,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

I have the honour to present herewith for your consideration, the Report of the Entomological Society for 1919.

Respectfully submitted,

MANNING W. DOHERTY,

Minister of Agriculture.

Toronto, 1920.

CONTENTS

Entomological Society of Ontario

OFFICERS FOR 1919-1920

President—Mr. Arthur Gibson, Entomological Branch, Dept. of Agriculture, Ottawa.

Vice-President—Mr. F. J. A. Morris, M.A., Peterborough.

Secretary-Treasurer—Mr. A. W. Baker, B.S.A., Lecturer in Entomology, O. A. College, Guelph.

Curator—Captain G. J. Spencer, B.S.A., O. A. College, Guelph.

Librarian—Rev. Prof. C. J. S. Bethune, M.A., D.C.L., F.R.S.C., Professor of Entomology and Zoology, O. A. College, Guelph.

Directors—Division No 1, Mr. J. M. Swaine, Entomological Branch, Dept. of Agriculture, Ottawa; Division No. 2, Mr. C. E. Grant, Orillia; Division No. 3, Dr. A. Cosens, Toronto; Division No. 4, Mr. F. J. A. Morris, Peterborough; Division No. 5, Mr. J. W. Noble, Essex; Division No. 6, Mr. J. F. Hudson, Strathroy; Division No. 7, Mr. W. A. Ross, Vineland Station.

Directors (ex-Presidents of the Society)—Rev. Prof. C. J. S. Bethune, M.A., D.C.L. F.R.S.C., Guelph; Prof. John Dearness, Vice-Principal, Normal School, London; Rev. Thomas W. Fyles, D.C.L., F.L.S., Ottawa; Prof. Wm. Lochhead, B.A., M.S., Macdonald College, Que.; John D. Evans, C.E., Trenton; Prof. E. M. Walker, B.A., M.B., F.R.S.C., University of Toronto; C. Gordon Hewitt, D.Sc., F.R.S.C., Dominion Entomologist, Ottawa; Mr. Albert F. Winn, Westmount, Que.; Prof. Lawson Caesar, M.A., B.S.A., O. A. College, Guelph.

Editor of "The Canadian Entomologist"—Prof. E. M. Walker, Toronto.

Delegate to the Royal Society of Canada—The President.

FINANCIAL STATEMENT

For the year ending October 31st, 1919

Receipts.		*Expenditures.*	
Cash on hand, 1917-18	$57 28	Expense	$25 50
Advertisements	46 00	Printing	1550 07
Back Numbers	192 10	Annual meeting	105 65
Members' Dues	124 40	Annual Report	25 00
Subscriptions	470 11	Salary	100 00
Bank Interest	2 64	Library	3 50
Government Grant	1000 00	Cash on hand	82 81
	$1892 53		$1892 53

To balance due on printing	$230 81
By cash on hand	82 81
Net Deficit	$148 00

Auditors: L. Caesar.
J. E. Howitt.

Entomological Society of Ontario

ANNUAL MEETING.

The Fifty-sixth Annual Meeting of the Entomological Society of Ontario was held at Ottawa on Thursday and Friday, November 6th and 7th, 1919. The chair was occupied by the President, Prof. L. Caesar.

The following members were present: Prof. W. H. Brittain, Truro, N.S.: Mr. George Sanders, Annapolis Royal, N.S.: Mr. J. D. Tothill, Fredericton, N.B.: Prof. W. Lochhead, Macdonald College, Que.: Mr. A. F. Winn. Westmount, Que.: Dr. J. A. Corcoran and Mr. G. C. Moore, Montreal, Que.: Rev. Father Leopold and Mr. F. Letourneaux, Oka, Que.; Mr. C. E. Petch, Covey Hill, Que.: Dr. C. G. Hewitt and J. McDunn: Messrs. A Gibson, J. M. Swaine, C. B. Hutchings, E. F. Strickland, F. W. L. Sladen, C. B. Gooderham, J. I. Beaulne, L. S. McLaine, V. Kitto and Drs. J. McDunnough and S. Hadwen, Ottawa, Ont.: Mr. F. J. A. Morris, Peterborough, Ont.; Mr. H. F. Hudson, Strathroy, Ont.: Mr. W. A. Ross, Vineland, Ont.: Mr. N. Criddle, Treesbank, Man., and Mr. R. C. Treherne, Vancouver, B.C.

Among the visitors were Mr. C. L. Marlatt, Washington, D.C.: Prof. Cummings, Mass.; Prof. W. A. Macoun and Mr. E. S. Archibald, Ottawa.

Letters of regret at their inability to attend the meeting were received from the following: Dr. W. E. Britton, New Haven, Conn.: Prof. G. C. Crampton, Amherst, Mass.: Dr. E. P. Felt, Albany, N.Y.: Dr. H. T. Fernald, Amherst, Mass.: Dr. T. J. Headlee, New Brunswick, N.J., and Mr. J. J. Davis, Riverton, N.J.

On Thursday morning a meeting of the Council was held at which several matters of importance to the Society were brought up and discussed. In view of the increasing deficit shown by the Treasurer's Report it was decided that the fee to Canadian members of the Society, including members of Branches, be increased to $2.00, and that in lieu of all expenses only the railway fares of the Directors and Officers of the Society be paid.

In the afternoon the general meeting was called to order by the President and the proceedings commenced with the reading of the Report of the Council, followed by those of the Treasurer, Librarian, Curator and of the various Branches of the Society.

REPORT OF THE COUNCIL.

The Council of the Entomological Society of Ontario begs to present its report for the year 1918-1919.

The Fifty-fifth Annual Meeting of the Society was held at the Ontario Agricultural College, Guelph, on Wednesday and Thursday, December 4th and 5th, 1918. Owing to the prevalence of influenza, the meeting was held at a much later date than usual. The chair was occupied by the President, Professor Lawson Caesar, O. A. College. The attendance was very good, including members of the Society from Nova Scotia, New Brunswick, Quebec, Ontario and Manitoba. Mr. J. J. Davis, West Lafayette, Ind., Prof. J. P. Parrott, Geneva, N.Y. and Prof R. Matheson, Ithaca, N.Y., were welcome visitors.

By the kindness of Dr. Creelman, all those in attendance who came from a distance, were entertained in the College Residence during their stay in Guelph. This arrangement added much to their pleasure and comfort by affording many opportunities for social converse and by saving the time usually spent in travelling to and from the town. This hospitality was greatly appreciated by all present, and a hearty vote of thanks was accorded at the close of the meeting to President Creelman and to the Matron and the Superintendent of the Dining Hall.

At a meeting of the Council, held on Wednesday morning, it was decided to enlarge the pages of *The Canadian Entomologist* in order to be uniform with the standard size of bulletins, and also to issue ten instead of twelve numbers per annum, but at the same time to make no reduction in the amount of reading matter.

During the afternoon of Wednesday and on Thursday, a number of interesting and valuable papers were read and discussed, of which the following is a list:—Reports on insects of the year in their respective districts by Directors, Dr. A. Cosens, Toronto, Mr. F. J. A. Morris, Peterborough and Mr. J. W. Noble, Essex. Insects of the season in Ontario, by Mr. W. A. Ross, Vineland, and of Quebec by Mr. G. Maheux, Quebec; "Aphids; their human interest," by Dr. A. C. Baker, Washington, D.C.; "Insect problems in the Prairie Provinces," by Mr. Norman Criddle, Treesbank, Man.; "The recovery in Canada of the Brown-tail Moth Parasite, Compsilura concinnata," by Messrs. J. D. Tothill and L. S. McLaine; "The Life-history of a Hobby Horse" by Mr. F. J. A. Morris; "Present day problems in Entomology," by Mr. J. J. Davis; "Insects as agents in the dissemination of Plant Diseases," by Prof. Caesar; "The Cabbage-root Maggot," by H. C. Huckett; "Some chapters of the early history of Entomology," by Prof. Lochhead; "The Pear Psylla in Ontario," by Mr. W. A. Ross; "Our Garden Slugs," by Mr. G. Maheux; and "The Entomological Record for 1918," by Mr. Arthur Gibson. The reports of the Montreal, Toronto, Nova Scotia, and British Columbia Branches and of the Librarian and Curator were also presented and read.

The Canadian Entomologist, the official organ of the Society, completed its fiftieth volume in December last; the event was commemorated by a poem from the pen of Mr. F. J. A. Morris, which opened the fifty-first volume. This volume will be completed by the issue of the forthcoming November and December numbers. The semi-centennial volume contained 433 pages, illustrated by 12 full page plates and 21 figures in the text. The contributors to its pages numbered 57 and included writers in Ontario, Quebec, Nova Scotia, Manitoba, Alberta and British Columbia, and also in twelve of the United States. In the systematic articles there were described five new genera, 103 new species and four new varieties of insects. The series of papers published each month on "Popular and Practical Entomology" has continued to form an attractive as well as an instructive feature for the benefit of the general reader.

The number of members of the Society continues to be much the same from year to year. At the end of 1918 there were 179 on the list, including those on military service overseas. During the current year 26 have left us owing to deaths and withdrawals, while the same number of new members has been added to the roll.

It is again the sad duty of the Council to record the loss of one of our ablest and most active Entomologists, Mr. Frederic Hova Wolley Dod, of Midnapore, Alberta, who died of Enteric Fever on the 24th of July, at 49 Hospital, Chanak. His rank was Second Lieutenant in the Yorkshire Light Infantry attached to the

Macedonian Labour Corps. Though beyond the age prescribed for military service, his patriotic spirit compelled him to do what lay in his power for the welfare of the Empire. He accordingly went to England and succeeded in obtaining a commission and being sent out with a Labour Corps to Macedonia. Mr. Wolley Dod devoted himself to the Lepidoptera and became the highest authority in North America on the Noctuid Moths. He published in the *Canadian Entomologist* a long series of papers, extending over many years, on the synonymy and classification of this difficult family.

REPORT OF THE LIBRARIAN.

Owing to the lack of funds available for the purpose, only one book has been bought for the Library during the year now drawn to a close, namely, "Illustrations of the North American species of the genus Catocala" by Drs. Barnes and McDunnough, published by the American Museum of Natural History, New York. Seven bound volumes have been received, making the total number 2,292. A notable gift to the Library has been made by the Rev. Dr. Fyles, a Life-member and Ex-President of the Society. It is a large folio volume, handsomely bound in red leather and entitled "Illustrations in Natural History." It contains 107 water-colour drawings, chiefly of insects, but including a few depicting flowers, birds, reptiles and other creatures. It was presented by the author "as a token of his appreciation of the great pleasure and profit his connection with the Society has afforded him."

The Library continues to receive a large number of periodicals in exchange for *The Canadian Entomologist* and a great variety of bulletins, reports and pamphlets, many of which should be collected into volumes and bound for convenient reference.

CHARLES J. S. BETHUNE, *Librarian.*

REPORT OF THE CURATOR.

Mr. Eric Hearle resigned the position of curator last spring on account of his departure for British Columbia where he has been studying mosquitoes during the summer. In the meantime I have myself, assisted at first by Mr. H. G. Crawford and later by Mr. G. J. Spencer, looked after the collection. They are all in good condition and have been so throughout the year. Very few new insects have been added.

L. CAESAR, *President.*

REPORT OF THE TORONTO BRANCH.

October 9th, 1919.—The 23rd Annual Meeting of the Toronto Branch was held in the Biological Building of the University of Toronto.

The report of the Council showed that seven regular meetings and one annual meeting were held during the year, and that the average attendance was fifteen persons.

The annual meeting held on November 21st, 1918 was an open meeting for general discussion of entomological topics. But at the regular meetings a variety of papers were read, these were as follows:—

Dec. 6th,1918—"The Natural Control of Insects." By Mr. John D. Tothill, of Fredericton, N.B.

Jan. 9th, 1919—"Insects as Food of Trout." By Dr. W. A. Clemens.

Feb. 6th, 1919—"A Month on the Lower St. Lawrence." By Dr. E. M. Walker.

Feb. 27th, 1919—"Notes on the Biology of Stoneflies." By Mrs. W. A. Clemens.

Mar. 21st, 1919—"Insect Life in British Honduras." By N. K. Bigelow.

April 24th, 1919—"Investigations into the Habits of the Nymphs of the Mayflies of Genus Chirotonetes." By Dr. W. A. Clemens.

Also "Insectivorous Birds in Ontario." By Dr. E. M. Walker.

May 29th, 1919—"The Food and Feeding Habits of some Larval Hymenoptera." By Dr. A Cosens.

The report of the Librarian showed that many publications had been received during the year, and that these had been catalogued and filed.

The financial statement showed a balance on hand of $22.47.

It was owing to the epidemic of influenza in the autumn of 1918 that the annual meeting was not held until November.

Three new members: Mrs. W. A. Clemens, Mr. N. K. Bigelow, and Mr. H. Hesket were elected during the year.

After the reading of the annual report, one new member, Mr. R. W. Hall, was nominated and elected a member of the Toronto Branch.

The election of officers was then proceeded with, the results were as follows:

President, Mr. H. V. Andrews; Vice-President, Mr. S. Logier; Secretary-Treasurer, Miss Norma Ford; Librarian, Mr. N. K. Bigelow; Council, Dr. E. M. Walker, Dr. W. A. Clemens, Dr. A. Cosens, Mr. T. B. Kurata, Mr. J. Hannibal, Mr. C. K. Brobst.

When the annual business was finished the meeting was left open for general discussions in entomology and for notes and observations of the season. Those present at the meeting were: Dr. Clemens, Dr. Walker, Miss Ford, Mr. A. W. Baker of the Parent Society, Messrs. Andrews, Hannibal, Wright, Bigelow, Hall, Logier, and two visitors.

It is with sincere regret that the Toronto Branch record the death of Mr. Chas. M. Snazelle, who had been a member since 1912. During the last two years he had been unable to attend the meetings owing to business obligations in connection with war work. Mr. Snazelle was an enthusiastic student of nature both in entomology and in other branches, and his presence at our meetings will be greatly missed through the coming days.

Shelley Logier, *Sec.-Treasurer.*

REPORT OF THE MONTREAL BRANCH.

The 46th Annual Meeting of the Montreal Branch of the Entomological Society of Ontario was held in the Lyman Entomological Room, Redpath Museum, McGill University, on May 17th, 1919.

During the season 1918-1919 we held eight meetings with a total attendance of seventy or an average of nine per meeting. This was smaller than that of the

previous season, which however was the largest on record because of a large public meeting held in 1918. We did not hold such a meeting during the past season, but nevertheless we had successful meetings and the interest was keen.

We have added several recruits to our ranks and hope they will all become ardent entomologists.

We held our regular Victoria Day outing to St. Hilaire and those who were able to go were rewarded as usual from this good collecting ground.

Our Society provided the programme at the Natural History Society's meeting in March.

The Treasurer's Report showed a balance of $158.61 on hand.

The following papers and talks were given during the year:—

1. Annual Address, Subject "Tables"	A. F. Winn.
2. Collecting in California	H. F. Simms.
3. Preparation of Hemiptera lists	Geo. A. Moore.
4. Hemiptera taken at St. Hilaire, May 24th, 1918	Geo. A. Moore.
5. Larvæ of Parnidae	Dr. F. S. Jackson.
6. Notes on the Season 1918—"Hemiptera"	Geo. A. Moore.
7. Argynus apachana St. and Edwards' Plates of A. nokomis	A. F. Winn.
8. Economic importance of Samia Cecropia	Dr. Corcoran.
9. Enodia portlandia Fab. at Oka	G. Chagnon.
10. Zerene cæsonia Stal. the Dog's Head Butterfly	A. F. Winn.
11. On which plant to collect Chalæpus nervosa Say	Brother Ouellet.
12. The Milkweed Bug. Lygæus Kalmii Stal.	Geo. A. Moore.
13. British Burnets	Lachlan Gibb.
14. Muscoid larvae found in a human patient	Dr. F. S. Jackson.
15. The Raspberry Root Borer or Clear Wing Borer, Bembecia marginata Han.	A. F. Winn.
16. Notes on some localities outside Montreal Island	Brother Ouellet.
17. The Periodical Cicada	Geo. A. Moore.
18. Lantern Lecture, Nature Photography	G. H. Hall.
19. Cercopidæ, Spittle Insects	Geo. A. Moore.

Geo. A. Moore, *Secretary.*

REPORT OF THE BRITISH COLUMBIA BRANCH.

The 18th Annual Meeting of the British Columbia Branch was held in the biology lecture room at the University of British Columbia, Vancouver, on Saturday, March 15th, 1919. In the absence of the President, Mr. R. S. Sherman, owing to sickness, the chair was taken by the Vice-President for the Coast, Mr. W. Downes.

The Secretary-Treasurer, Mr. Williams Hugh, presented his financial statement and report as librarian. The morning session included the following programme:—

Discussion on Aims and Objects of the Society.
Resolutions.

Notes on Tubuliferous Thysanoptera	R. C. Treherne.
Stray Notes on B. C. Lepidoptera	E. H. Blackmore.
Common Tree-hoppers of B. C.	W. Downes.
Some descriptions of New Species of Mycetophilidae	R. S. Sherman.

Afternoon Session.

A Swarm of Vanessa californica .... J. W. Cockle.
The Lycaenidae of B. C. .... E. H. Blackmore.
(Illustrated with Specimens)
The Locusts of B. C. .... E. R. Buckell.
Discussion by Thos. MacKenzie, B. C. Commissioner of grazing.
Notes on European Foul Brood in B. C. .... Williams Hugh.
Cutworm Control .... Mr. H. Ruhman.
Life Histories and Control of Our Strawberry Insects .... W. Downes.

Evening Session.

The Onion Maggot .... Mr. H. Ruhman.
Tent Caterpillars, their life-history and control .... A. B. Baird.
The Alfalfa Seed Chalcid .... E. R. Buckell.
Insect notes of the year, leading a discussion on control of injurious insects affecting Agriculture .... R. C. Treherne.

The officers elected for the year 1919 were as follows:—

Hon. President.............................. F. Kermode, Victoria
President .... E. H. Blackmore, Victoria.
Vice-President (Coast) .... R. S. Sherman, Vancouver.
Vice-President. (Interior) .... J. W. Cockle, Kaslo.
Hon. Secretary-Treasurer.............................. W. Downes, Victoria.
Advisory Board.............................. Messrs. Lyne, R. C. Treherne, G. O. Day, John Davidson, L. A. Breun.

Among the resolutions passed was one providing for prizes at the principal fall fairs for the best exhibits of insects collected by students attending the public schools, $100.00 being voted for this purpose from the Society's funds.

The Society at the present time is in a flourishing condition and although interest in the Society's work diminished during the war, in which two valued members lost their lives, we have since been strengthened by the addition of several new members and signs are not wanting that interest in the work of the Society will continue to increase.

W. Downes, *Hon. Secretary-Treasurer.*

REPORT OF THE NOVA SCOTIA BRANCH.

The Fifth Annual Meeting of the Entomological Society of Nova Scotia was held at the College of Agriculture, Truro, on July 31st. The morning session was devoted to a report of the Society's work, financial statement, and the general business of the Society. During the afternoon and evening a number of papers were read by various members.

The following officers for the year were elected:—

Honorary President.............................. Dr. A. H. McKay, Halifax.
President .... W. H. Brittain, Truro.
Vice-President .... J. D. Tothill, Fredericton.
Secretary-Treasurer .... A. Kelsall, Annapolis Royal.
Asst. Secretary-Treasurer .... E. A. McMahon.
Committee .... W. N. Keenan, G. E. Sanders. Miss Dora Baker.

During the year, No. 4 of the Proceedings of the Entomological Society of Nova Scotia was issued, a publication comprising about a hundred pages. Besides including a great deal of new data on the insects of the Maritime Provinces, it contains several articles on comparatively new, or modified, insecticide-fungicide combinations, which are proving to be of considerable economic value.

A. Kelsall, *Secretary.*

REPORTS ON INSECTS FOR THE YEAR.*

Division No. 3, Toronto District—A. Cosens.

The frail structure of many insects adapts them only to the warmth and soft breezes of summer, not to the cold and bitter gales of winter. In bridging the period of low temperature the casualties must be heavy among these fairy-like creatures of sunny, dreamy days. Last winter was so uniformly and extremely mild that the hibernating conditions of many groups of insects were no doubt ameliorated, and, as a result, an unusually large number of survivors awakened into activity at the beginning of the season.

This may explain in part the abundance of several species of butterflies. On May 7th, which was a very warm spring day, many specimens of the Red Admiral, *Vanessa atalanta,* emerged from their winter hiding-places. Dozens of them were skimming lazily over the lawns or flitting about among the blossoms of the Norway maples. From that date throughout the whole summer these butterflies were exceedingly numerous, more so than for many years. Later in the season, the Painted Lady, *Vanessa cardui,* also became very plentiful and continued so until nearly the end of August. The Banded Purple, *Basilarchia arthemis* usually a rather scarce butterfly in this locality, was quite frequent along the paths in the parks. Its relative, the Viceroy, *Basilarchia disippus,* never a rare insect here, was this summer, however, uncommonly abundant.

The hibernating habits of these last two species are such as to point to the possibility of a close relation between their unusually large numbers and the mildness of the winter. As soon as the nights begin to become cool, the caterpillars of the butterflies commence the preparation of their winter quarters. The larva selects a suitable leaf on its food plant, and bites off the blade on each side of the midrib, leaving only two flaps at the base. The whole of the leaf remaining is then covered with silk, and the flaps are drawn together so as to form a cosy silk-lined nest. To prevent the leaf from falling some of the threads of silk, that covered its stalk, were passed around a branch of the plant. Into this Esquimaux-like sleeping-bag the caterpillar then crawls, and remains in its snug retreat until the spring sun has burst the buds on its food plants.

Gardeners state that the Cabbage Butterfly, *Pieris rapae,* has been very trouble some this season. It is only seldom that the southern relative of this form comes so far north, but on August 1st, I captured a much-worn female specimen of *Pieris protodice.* The latter species has never proven injurious in Ontario, but is occasionally numerous enough to become destructive in some of the states to the south of us. Throughout the whole of its range, however, this native American butterfly is being gradually driven out by the alien from Europe. The latter, by ovipositing earlier and raising more broods a year, has been able to gain possession of almost all the available, cultivated Cruciferous plants, limiting the former to the wild species only.

*For Report of Division No. 6, see p. 83.

August 1st must have been a red-letter day in the entomological calendar as I find in my notes that on that date I captured also the Zebra or Papaw Butterfly, *Iphiclides ajax* var. *ajax*. A strong southern wind that had been blowing for a couple of days may account for these rare stragglers from the south. Speaking of Papilios, it is interesting to note that the Pipe-vine Swallow-tail, *Papilio philenor,* is becoming less rare in this district. This is probably due to the increasing popularity of its favourite food-plant, the Dutchman's Pipe, *Aristolochia macrophylla,* for ornamental purposes.

Although many species of butterflies were exceedingly common this season the Monarch, *Anosia plexippus,* was much less plentiful than usual. I saw only four specimens, and these late in the year—September 7th, 9th and 14th. In a note just received from Mr. C. W. Nash he states that he saw a specimen on each of the dates, September 26th, October 4th and 5th. These butterflies, that have visited us so late are probably members of the rear guard of the migrating columns on their treck to the south from a more northerly summer home.

The Entomological season was opened on April 5th this year by the finding of four specimens of the Ground Beetle, *Calosoma calidum.* In spite of the early date, a pair of these insects were already mated. On two occasions this summer I have seen the larvæ of Ground Beetles attacking earthworms. The beetles were finding their prey rather large, and one at least of the worms escaped.

Some variation in the conditions has proven favourable to the production. this season, of the gall *Andricus operatola* Bassett. On the ground, under several oak trees, infested acorns were plentiful. In previous years it has been rarely that I have found the gall, and never before attached to the acorns. The specimens obtained had dropped from the acorns which had remained on the trees.

This pointed, tooth-shaped gall is enclosed between the cup and the acorn, but originates from the latter. In general the gall projects only slightly above the edge of the cup. Often four or five galls are found irregularly spaced around the base of an acorn. In this locality both red and black oaks act as hosts.

From the galls, that have remained on the ground over winter, producers emerge early the next spring.

Division No. 4, Peterborough District—F. Morris, Peterborough.

One or two items only seem worthy to be reported in this season's collecting. The interruption of school work owing to influenza, in October and November, necessitated the extension of the summer term till the end of June; almost immediately after, your director passed to examination work till late in July. Field observations were very few and not of much value.

Among the collections handed in by pupils at the Peterborough Collegiate was noticed a very rare borer in alder, *Saperda obliqua,* and a member of the staff captured three or four specimens of *Phymatodes dimidiatus* in the latter part of May, the captures being made in his woodshed. A few days after a pupil brought in a specimen of *Saperda puncticollis* just captured on Virginia Creeper. This insect had been taken two or three times by pupils and I was very anxious to make observations. Enquiries had always pointed to Virginia Creeper rather than Poison Ivy as the food plant. The Science teacher accordingly hurried over to examine the vine and captured four or five more specimens, as well as specimens of *Psenocerus supernotatus* emerging from dead stems of the same plant. On learning of the discovery I hurried over to our opposite neighbor's where the low wall is overgrown with the plant in question. I captured over a score of the first insect and three or four of the second. Casual search on four or five other vines

of Virginia Creeper at different parts of the city secured further specimens of both insects. The beetle is quite the prettiest of the Saperdas, but small, shy, and easily overlooked. In the hot sun it often climbs out to the surface of the upper leaves, but takes to wing very readily and drops as readily into the heart of its shrubbery. The period of emergence and activity lasts about a fortnight; from May 27th to June 10th. Large numbers of a clearwing moth were observed frequenting blossoms along the edge of a corduroy road through the heart of a tamarac swamp, but so far the insect has not been determined. No other insects of interest have been noted by your observer this season.

Division No. 5, Essex District—J. W. Noble, Department of Agriculture, Essex.

Attacking Field Crops. Hessian Fly has been very conspicuous in its work this year, large acreages of wheat have been cut down in yield 50 per cent. and even some of the later sown wheat planted in the fall of 1918 have been badly attacked. A great deal of injury has already been noticed this fall. It is altogether likely to be as bad in 1920 as this year. Grasshoppers and crickets were quite bad in June owing to extremely dry weather prevailing at that time. Considerable damage was done to cereal grains and some other crops by these insects. Wire-worms and cutworms did a great deal of damage in the spring of 1919. Cut-worms have been quite successfully controlled by the poison bran mixture.

Attacking Fruit Trees. The Codling Moth has possibly never been worse in this county owing to the exceptionally favourable season for its development. Even well-cared-for orchards are heavily infested with this insect. Where the spraying was omitted in the season of the year three weeks after the blossoms have fallen the sideworm injury is especially conspicuous, but in well-cared-for orchards that received the calyx cup spray very little injury has been noticed from the blossom end. A considerable number of specimens at work of Plum Curculio have been submitted for identification, but commercially speaking, the Codling Moth has been much the worst insect on fruit trees.

Fruits and Vegetables. The Onion Marsh at Leamington where about 500 acres were grown this year had considerable trouble from both root maggot and onion thrips. Very little success has been obtained from trying to combat either of these pests.

Aphids were very bad this season on cucumbers but did not seem to do much damage to melons. The general use of Black Leaf 40 and tobacco decoction have been very successful in combating these insects. Tomatoes have been greatly infested this year with Tomato Sphinx, crickets and grasshoppers. Cauliflower plants have suffered considerably from crickets gnawing the stems above the roots. Considerable dame was done, but wet weather checked their depredations before poison solution could be tried.

Tobacco was attacked by the usual pests, the tobacco sphinx being very plentiful this year. Dusting the small plants with arsenate of lead, spraying the partly grown plants with solution and spraying the larger plants with the dust gun when they were too large to allow the spray machine to be used successfully, controls these worms. Wire-worms did an exceptional amount of damage to tobacco plants this year and made the stand very uneven in many cases.

Greenhouse Insects. The usual greenhouse insects have been reported, but where proper methods have been used very little trouble has been reported. Greenhouse white fly, greenhouse aphids and nematodes are among the greenhouse man's worst enemies.

ENTOMOLOGICAL PROGRESS IN BRITISH COLUMBIA.

R. C. TREHERNE, ENTOMOLOGIST IN CHARGE FOR BRITISH COLUMBIA, DOMINION DEPARTMENT OF AGRICULTURE.

The products of entomological labors during the past year in British Columbia have been many and varied. In addition to my work as a Federal Officer under the Dominion Entomological Branch, I have undertaken the general direction of the Provincial Entomological work, pending the appointment of a Provincial officer. Under the Dominion Entomological Branch, Messrs. W. Downes and E. P. Venables are engaged, the former on a study of small fruit insects in the Coast sections and the latter on a study of tree fruit insects in the interior of the province. Mr. A. B. Baird is stationed at Agassiz, B.C., working under the general direction of Mr. J. D. Tothill, who has charge of the Federal Natural Control Investigations. His work has been mainly a study of the natural control agencies of the Tent Caterpillar, the Fall Webworm and the Spruce Bud-worm, and these studies begun by Mr. Tothill in 1917 have been continued by Mr. Baird in 1918 and 1919, at Victoria, Vancouver, Agassiz and Lillooet. Mr. Eric Hearle commenced a study of the mosquitoes in the Lower Fraser Valley of British Columbia in March 1919, acting conjointly under the authority of the Dominion Entomologist and under a studentship granted by the Honorary Advisory Council for Scientific and Industrial Research, and he will doubtless not only continue this work in the Lower Fraser Valley but extend it over the province at other important centres. Mr. Ralph Hopping was appointed under Dr. J. M. Swaine, Chief, Dominion Division of Forest Insects, in December, 1919, and he is stationed at Vernon, B.C., engaged on the studies relating to certain forest infesting insects, particularly some *Dendroctonus* beetles affecting commercial pine.

Under the Provincial Entomological Branch, I am fortunate in being associated with Messrs. M. H. Ruhman and E. R. Buckell. The former is engaged in a study of vegetable insects and has made the study of the Root Maggots of the onion and the cabbage his special work during the past two years. Mr. Buckell has taken in hand studies relating to cereal and range insects, the most pressing problem, at the present time, being the control and investigation of locusts on the range.

Vernon, at the north end of Okanagan Lake, has been selected as the headquarters for entomological work in the Province at the present time. Here the central office is located with a reference library and collection of insects for study available to members of the staff, and Riker Mounts and photographic displays of insect pests, in appropriate arrangements, of interest to farmers. Branch laboratories have been established at Victoria, Agassiz and Mission. Another movable laboratory was stationed at Penticton in 1919 but doubtless will be located in the Chilcotins in 1920.

During the past year, 1919, the following investigations have been conducted, excluding the reports of Messrs. Hearle and Baird, who will issue the results of their work independently.

The Peach Twig Borer, *Anarsia lineatella,* was studied at Penticton, making the second consecutive year in which this insect has received attention. We are satisfied that the early application of lime-sulphur, 1-9, as close to, but previous to, the blossoming period as possible, will achieve good commercial results. Applications of arsenate of lead may be made immediately after blossoming with

equally good results. The two applications of spray may be made in cases of severe infestation. This insect is known to attack prunes, plums, peaches, apricots, and cherries, and where these fruits are seriously attacked the same procedure for control, as outlined above, may be followed.

Certain studies were undertaken at Vernon this year to breed to maturity the various "worms" affecting fruit. This work was carried out to determine with accuracy the species present in the fruit orchards and to differentiate between the larvæ of the various species for the purpose of assisting in diagnosing outbreaks of Codling Moth. The following species occur: *Tmetocera ocellana, Argyroploce consanguiniana, Cacoecia rosaceana, Mineola tricolorella,* and *Laspeyresia prunivora.*

Insect distributors of fire blight were also the subject of study. Many insects received attention in this connection and while some were incriminated as carriers of both summer and winter blight, it is not believed that their control will either eliminate the disease or control it to the extent expected by many growers.

The Strawberry Root Weevil, *Otiorhynchus ovatus,* is still being subjected to investigation, the main line of work being a demonstration in the principles of crop of rotation. A section of land has been engaged for a period of six years to put into practice the remedies for this weevil which we believe may be successfully held in control by cultural methods. Mr. W. Downes, assistant in charge of this work, has recently shown that the weevils are parthenogenetic and that certain overwintering females may oviposit in the early spring months.

The chief small-fruit insects, with the exception of the Strawberry Root Weevil, which is the most serious, are the following: *Bembecia marginata, Phorbia rubivora, Aristotelia fragariae, Synanthedon rutilans, Epochra canadensis,* and an *Empoasca* of the Loganberry. It is hoped that all these insects will be studied closely during the next few years. With *Epochra canadensis* we have been unable, thus far, to prove any value from the poisoned bait spray and are still recommending growers to rely on cultivation and the use of chickens to rid themselves of this pest.

Among the vegetable insects the Cabbage Root Maggot and the Onion Maggot were each the subject of considerable study. The bulk of the work against the Cabbage Root Maggot is recounted on another page of these proceedings. The work against the Onion Maggot has not resulted, as yet, in our being able to offer definite recommendations for control under field conditions as they pertain to the Okanagan Valley. Our efforts to test the value of the poisoned bait spray have not apparently been rewarded with success. Our inclinations lead us to believe that late thinning and the use of a spring trap crop have considerable value, and in this belief our growers are recommended, at present, to plant a few rows of cull onions, 3-4 inches deep in the soil, in the early spring months, allowing the onions to sprout and thus act as a trap crop for the first generation of the fly. The work with the poisoned bait spray, which is, according to report, giving very good results in Eastern Canada and in the Eastern United States, is being continued. Consequently it is hoped that our recommendations will assume a more definite state in a few years' time.

Among the insects affecting grain and range crops, the locusts situation received considerable attention during the past year. The main species involved were *Camnula pellucida, Melanoplus atlanis* and *M. femur-rubrum.* The paper in this number of the Proceedings by Mr. E. R. Buckell, on some ecological and life history notes of locusts, covers in part, the work accomplished.

Spraying investigations that are being carried on, at present, in the Province, are being maintained by the Provincial Horticultural Division. Their main in-

vestigations have been conducted against the Green Apple Aphis, in order to determine the cheapest spray to apply; and against Apple Scab where different mixtures, strengths, and formulae have been used in test against each other. The Codling Moth field work has also been in the hands of the Provincial Horticultural authorities, working in association with the officers of the Entomological Branch. Approximately 223 acres of apple orchards were handled under quarantine in the neighbourhood of Vernon during the past year. 107 acres of this 223 were infested with Codling Moth in the year previous, 116 acres were contiguous to the infested area and were treated as though infested. 11,422 apple trees in this acreage were banded and were sprayed three times, and at the end of the season 19,401 boxes of apples were individually examined for larvæ. Altogether 373 larvæ and pupae of the Codling Moth were taken at Vernon, and as Vernon, during 1919, was the only point in the Okanagan Valley where examples of this moth were taken, the control operations have succeeded to a very creditable degree. A few years ago three distinct and separate outbreaks of the moth occurred in the Okanagan Valley, with as many as 10,000 larvæ being taken in a single year. The record as it stands, therefore, is not only very encouraging but is an indication that incipient outbreaks, in small areas, with proper support by the growers, can be not only reduced but also eradicated. A small new outbreak of this pernicious pest occurred at North Bend this year, which will necessitate action this coming year.

The Tent Caterpillars, *Malacosoma pluvialis* and *M. erosa* were exceedingly common at Vancouver and Victoria in 1919. The outbreak at certain points being exceptionally severe. A memorandum outlining the method for control was submitted to the City Councils of the Cities of Vancouver and Victoria, but with this exception, these insects were studied exclusively by Mr. Baird.

Many sundry insect notes were collected during the course of the year and the more important minor records have been incorporated in a report to the Department of Agriculture, Victoria, B.C. A similar report for the year 1918 was submitted in the same way to the Provincial Department of Agriculture and was published in two sections in the official organ of the Department, the *Agricultural Journal.*

RESULTS OF SOME PRELIMINARY EXPERIMENTS WITH CHLOROPICRIN.

G. J. Spencer, O. A. College, Guelph.

In 1917, when meditating upon the effects of enemy gas that I had received at Passchendaele it occurred to me that British gas might be turned upon enemies other than Germans.

The opportunity to try this out came in the spring of 1919 when the Khaki University of Canada obtained permission for men of the Canadian forces to study at British Universities. I went to Victoria University, Manchester, where through the courtesy of Prof. S. J. Hickson, I was given the run of the research laboratory and the insectaries at Fallowfield. From the explosives department of the Ministry of Munitions I obtained samples of three of our common battle gases, one of them being chloropicrin, formula tri-chlor-nitrite.

It was decided to try the effects of these gases with a view to greenhouse, flour-mill and domestic fumigation. There was time to carry out only one experiment in Manchester before I was recalled to camp.

Experiment of Chloropicrin on Plants in a Greenhouse..

Capacity of greenhouse, 675 cubic feet approximately. Temperature in the house (June) 90° F. Ten cubic centimetres of gas were used in each of three petri dishes, two in opposite corners of the room on a table, and one on the floor. The nearest dish was right amongst the plants, which were: Recently potted dandelion in flower, Michaelmas daisy, wild vetch and curled dock, a geranium in a pot and cut boughs of willow. Insects present: Thrips, geometrid larvæ, leaf-rollers, Cercopidae, immature Jassidae and some Muscidae flying around the room.

A gas mask was used throughout the experiment in order to observe the action of the gas on the insects.

The leaf-hoppers were the first to show signs of distress by falling off the willow boughs six minutes after the gas was introduced. At the end of 10 minutes and 20 minutes respectively 10 cubic centimetres more of gas were poured out, this time on the floor making a total concentration of 50 c.c. After an exposure of 23 minutes the thrips were apparently all dead, although they had fallen out of the flowers after 11 minutes. At this time the Jassids and the immature Cercopids whose spittle masses had not been disturbed at all were also on the table moving feebly.

The experiment terminated in 38 minutes with the thrips, Jassids and Muscids all dead and the cercopids, the geometrid and leaf rollers very feebly moving. The doors and windows were opened and kept open until the house could be freely entered without discomfort, the gas being dispelled in 5 minutes. Next morning, i.e. after 17 hours those insects which had been feebly moving the day before were all dead. The cercopids alone, in untouched masses of spittle, were apparently unharmed. But all the plants were drooping badly, especially the vetch and michaelmas daisy, and at the same hour the second day, all the plants were dead.

In this experiment the temperature was very high and the relative humidity must have been high also as the floor of the house had been recently watered. But the volume of gas was very low, being for half the experiment only 30 c.c. and at the end of the experiment only 50 c.c. per 675 cubic feet, which amounts to only 3.7 oz. per 1,000 cubic feet.

With these results in mind, the following experiments were carried out at Guelph, the relative humidity being determined in each case:

1. Varying strengths of gas—other factors being equal.
2. Shorter or longer period of exposure.
3. Exposure by night and by day.
4. The killing power of the gas on various insects.

A good supply of Red Spider on salvia and of mealy bugs on coleus was available in the greenhouses of the College and as both these host plants show great susceptibility to killing by hydrocyanic gas, it was considered advisable to try the comparative value of chloropicrin on them.

Experiments were conducted at first in daylight, and proved that exposure to an atmosphere at the rate of 3 pounds of gas per 1,000 cubic feet, relative humidity 87, temperature 55.8° F. kill red spider effectively in 8 minutes—but kill salvia host plants in 5 minutes. And while 40 minutes exposure kills coleus and begonia, it does not kill all the mealy bug; those with their mouth-parts inserted in the stem of the plant seeming to survive those that were moving about. By next day young were issuing freely from the egg masses.

Effect of Gas on Various Insects.

The effect of the gas was tried also on leaf-hoppers and aphis on rose, red spider on salvia, tarnished plant bug and mites on aster and on cutworms. Temperature 66.2° F. Relative humidity 89. Concentration 3 lbs. per 1,000 cubic feet.

Result. Some leaf-hoppers died in 4 minutes, others in 14 minutes; red spiders and aphis seemed to be killed in 8 minutes. The aphis do not remove their beaks from the plant. On the insects being removed from the chamber at the end of 30 minutes, the capsids, cutworms and a few aphis that had been covered under a mass of leaves were still kicking feebly. After being exposed to the air for one hour everything was seen to be dead.

The action of choloropicrin on man is cumulative, and this would seem to be the case with insects also. In most instances, insects that may be kicking feebly when removed from the gas die after a while, even if placed in a current of fresh air.

Effect of rapid concentration. To determine if a sudden rush of gas would prove more effective even in reduced quantity, choloropicrin at the rate of 1½ pounds per 1,000 cubic feet was heated in a retort over a spirit lamp and the gas introduced into the chamber through rubber tubing. Mealy bug on begonia were the insects and plants used. Temperature 68° F. Relative humidity 82. The gas was practically volatilised in 14 minutes. When heating ceased and the plant was left in the chamber for two hours and then removed, on removal a few bugs showed signs of life but these died in three or four hours. Unfortunately the plant was withering at the time of removal.

Experiments at night. Finally, gas was used on red spider and mealy bug at night at a strength of 8.7 oz. per 1,000 cubic feet, temperature 59.0° F., relative humidity 99. Plants used salvia and coleus. Exposure lasted 90 minutes and by this time all red spider and mealy bug were dead; plants apparently normal. Next morning both species of plants were withering.

Inferences from foregoing experiments. It would seem that chloropicrin cannot be used for greenhouse fumigation as it has deadly effects on plants.

Penetration in earth. To test the penetration of the gas in earth, a flower pot about 7 inches deep, of ordinary greenhouse potting soil was used. Earth worms and millipedes were placed at different depths. (1) On the surface, (2) 1½ inches down, (3) 5 inches down. Experiments done at night, concentration at the rate of 8.7 oz. per 1,000 cubic feet. Time of exposure to gas 11 hours and 30 minutes. Temperature 55.4° F., relative humidity 88.

Result. Of those millipedes on the surface, some had crawled off the soil and some into it. Those at 1½ inches depth had gone deeper. At the end of the experiment all the millipedes and worms appeared dead, and while after 5½ hours the largest millipedes showed slight movement, the worms were all dried up. Eight hours afterwards another large millipede was bending slightly, but 12 hours after, all were dead without having moved from their original positions.

Effect of Chloropicrin on House Furnishings.

With a view to finding out if choloropicrin would have any effect on furnishings in houses, the following articles were exposed to its vapors for 12 hours: bright steel, copper, brass, silver, oatmeal wall paper with gilt splashings, several styles of lithographing in colors, cotton material, aluminum and varnished wood (as of cabinets). Relative humidity 88. Temperature 55.6° F.

Result. The gas has a tendency slightly to rust polished steel. Nothing else was affected. Exposure to the gas for 5 or 6 days, even at mild concentrations will rust steel badly. If however, the liquid itself should come into contact with cotton material, it will eat holes into it in a few days' time. Especially is this noticeable after the material has been washed. The gas has little or no action on rubber.

Effects of Chloropicrin on Grain, Meal and Flour Pests.

Into cotton bags containing respectively 2,000 grams of pure wheat flour, and 1,000 grams of a mixture of flour and bran, the following insects were placed in a position about half-way through the contents of the bags: Saw toothed grain beetle (*Silvanus surinamensis*), Meal worm (*Tenebrio molitor*), Drug store beetle (*Sitodrepa panicea*), Confused flour beetle (*Tribolium confusum*), Cadelle larvæ (*Tenebroides mauritanicus*), Granary Weevil (*Calandra granaria*). Temperature 63.5° F. Relative humidity 88 to 84. Concentration 8.7 oz. per 1,000 cubic feet. Time of exposure 25 hours and 15 minutes.

Of these insects, the meal worm larvæ alone moved through the flour either up or down. In both materials, flour and the flour bran mixture, all the adult and larvæ were killed. But 58.3 per cent. of the drug store beetle pupae were still alive when their cases were opened.

Effect of Chloropicrin on Meal Worm Moth Larvæ (*Plodia interpunctella*).

A packet of Quaker Oats, very heavily infested with all stages of meal worm moth was exposed to concentration of 8.7 oz. per 1,000 cubic feet for 24 hours. Temperature 64° F. Relative humidity 86. All stages of the pest were killed.

OUR COMMON CERCOPIDAE.

Geo. A. Moore, Montreal, Que.

As no doubt some here are not familiar with the Cercopidae, or at least do not know these interesting insects by their scientific name, I will begin by telling you their common name and the interesting feature that is characteristic of the family. They are most commonly known as Spittle insects, a term given them because of the habit the nymphs or young have of making a spittle-like froth in which they live.

Many curious explanations have been made to account for this frothy substance seen upon grasses and plants, which is sometimes so thick as to cover and wet a person's boots or clothes when passing through a field or path. Superstitious fear is sometimes felt by the uneducated, who steer clear of it. Some attribute it to frogs, hence the common name "frog spittle" is given, likewise "snake spit" is used in other localities. Negroes of the South claim that horseflies are produced from such masses.

So much now for this peculiar substance, let us now get to know the insect that produces it and afterwards we can learn why it is made and how.

The Cercopidae are a family in the sub-order Homoptera of the great order Hemiptera.

The Hemiptera includes the true bugs: cicadas, treehoppers, spittle insects, lantern flies, plant lice, and scale insects; the sub-order Homoptera all the above except the true bugs.

The Homoptera can be readily divided into two groups: (1) those in which the beak clearly arises from the head and (2) those in which the beak arises apparently from between the front legs or is absent.

Our Cercopidae belong to the first group and have associated with them:

The Cicadidæ —cicadas.
The Flugoridæ—lantern flies, etc.
The Membracidæ —tree-hoppers.
The Cicadelliaæ —leaf-hoppers.

Funkhouser has given their phylogenetic rank, beginning with the lowest, as follows:

1. Cicadidæ.
2. Membracidæ.
3. Jassidæ.
5. Fulgoridœ.
5. Cercopidæ.

The Cercopidae differ from the Jassidae by having only one or two teeth instead of a row of spines on their hind tibiae. They differ from the Membracidae by not having their prothorax prolonged into a horn or point above the abdomen. They differ from the Fulgoridae by having the antennæ inserted in front of and between the eyes instead of being inserted on the sides of the cheeks beneath the eyes.

According to Uhler the Cercopidae have characteristics which mark an important advance in the direction of the higher sub-order Heteroptera. Let us itemize the important features which lead to this decision.

1. The large size of the pronotum or prothorax is in contrast to the small one in the Fulgoridae and is not a phantastic ornament like that in the Membracidae. According to Uhler it is an important regional portion, exercising various important functions.

2. The increased freedom of the anterior coxae thereby approaching a walking insect.

3. The terminal portion of the wing covers being membranous and transparent suggesting the Heteroptera.

4. The hind tibiae having only one or two short stout spines.

In some respects therefore the Cercopidae represent the highest and most specialized forms of the Homoptera, and although most students consider the Fulgoridae to be the highest and most specialized there is evidence in favor of the Cercopidae occupying the position.

So much then for their rank. They are members of a sub-order approaching the higher sub-order and exhibiting interesting links between the two.

I have not yet observed the eggs and have read but few details of what they are like. They are slightly curved and cylindrical and are said to be deposited in the stems of grasses, plants and twigs.

The Cercopidae like other Hemiptera develop gradually, undergoing a series of moults and the young exhibit the characteristics of the adult, becoming more like it at each moult or instar, of which there are five.

They most likely hibernate here both in the adult stage and in the egg.

I have taken adults on May 24th of *Lepyronia quadrangularis*, and on June 20th *Philaenus spumarius*.

It is in the nymphal stage that they live within the frothy mass mentioned above. This substance is manufactured by the newly hatched nymph and they live within it until they emerge as adults. It was formerly supposed that this was made by thrashing about of the oval end of the body in a clear viscid fluid exuded from the posterior end of the body. Prof. E. S. Morse has, however, carefully observed the operation and states that the bubbles are made as follows: the insect exudes a clear viscid fluid from the posterior end of the abdomen, after a short time the posterior end of the abdomen is extended out of the fluid and as it were, grasps a quantity of air and then it is pulled down into the fluid and, the air released, making a bubble. This is continued at the rate of seventy or eighty times a minute. The tail is moved alternately to and fro so that the bubbles are distributed around its body.

Now what is the exudate for? According to most students it is a protective covering which, even if it is conspicuous, apparently serves the creature well. It is said that wasps know that in this juicy covering there is a goodly meal for their young and that they dive in and take the unfortunate nymph to its nest to feed its offspring. However, it would appear that it protects the young Cercopid well, both from the sun and from the ravages of spiders, birds, etc.

Dr. Ball has given some interesting facts upon Cercopidae living in arid regions where many of them do not make spittle masses. He records an interesting case where the nymphs were living in a gall-like sheath in a plant enlarged enough to harbour many of them, and all living in spittle. This was in the Cow Parsnip (*Heracleum lanatum*). In these arid districts others lived on the roots and crowns of Compositae and legumes where they were protected from the hot sun and dry air.

Lintner suggests that the covering is necessary to cover the delicate-skinned nymph from the burning heat of the sun.

The Cercopidae found in Canada are as follows:

Family CERCOPIDÆ (Leach)

SUBFAMILY CERCOPINÆ (Am. and Serv.)

No species.

SUBFAMILY APHROPHORINÆ (Am. and Serv.)

Genus Aphrophora Germ.

1546. *A. quadrinotata* Say. Quebec, Ontario.
1548. *A. parallela* Say. Nova Scotia, Quebec, Ontario.
1549. *A. irrorata* Ball. British Columbia.
1551. *A. saratogensis* Fh. Nova Scotia, Ontario.
1553. *A. signoreti* Fh. Ontario.

Genus *Lepyronia* Am. and Serv.

1555. *L. quadrangularis* Say. Nova Scotia, Quebec, Ontario, Manitoba.

Genus *Philaronia*.

1558. *P. abjecta* Uhl. Manitoba.
1559. *P. bilineata* Say. Quebec, Ontario, N. W. Canada.

Genus *Philænus*.

1560. *P. leucophthalmus* Linn. Quebec, Ontario, Manitoba.
   (a) Var. *falleni* V. D.
   (b) Var. *ustulatus* Fall.
   (c) Var. *lateralis* Linn.
   (d) Var. *leucocephalus* Linn.
   (e) Var. *marginellus* Fabr.
   (f) Var. *fasciatus* Fabr.
   (g) Var. *fabricii* Van D.
   (h) Var. *pallidus* Zett.
1561. *P. lineatus* Linn. Nova Scotia, Quebec, Ontario.

Genus *Clastoptera* Germ.

1562. *C. obtusa* Say. Quebec, Ontario.
(a) Var. *achatina* Germ.
(b) Var. *testacea* Fh.
(c) Var. *tristis* V. D.
1566. *C. proteus* Fh. Quebec, Ontario.
(a) Var. *proteus* Fh.
(b) Var. *vittata* Ball.
(c) Var. *pini* Fh.

The commonest Cercopid in the Province of Quebec is *Philaenus leucophthalmus* Linn. with its hosts of varieties. This insect is found swarming in meadows and Osborn has called it the meadow Froghopper. It feeds upon the common flowers, such as the buttercup, yarrow, thistle, daisy, clover, and particularly the golden-rod.

The egg is moderately elongated, irregularly elliptic, about three times as long as broad, narrowing to one end, slightly flattened. One side straight or slightly incurved, the outer convexly curved, giving the egg a slightly curved appearance. The shell is tough and hard and developed while the eggs are still in the ovariole ducts.

They are deposited in the stalks of their food plants and pass the winter there.

The young hatch out early in the summer, during June, and after passing through five stages emerge as adults throughout July and part of August.

The nymphs are somewhat like the adults even in the earliest stages and gradually become more like it. The fifth instar is to all intents and purposes a pupal stage and in their later stages show colour and have large wing-pads.

As already mentioned this species is extremely variable, running from plain yellow to black and having varied patterns. According to Fallemand in *Genera Insectorum*, there are at least seventeen well-marked varieties, and Van Duzee lists eight as occuring in America, north of Mexico. I have at least six distinct varieties, but there are many others and the intergrading makes it difficult to separate them. Different varieties mate together and it would be interesting to breed them and see what a brood would bring forth.

The second commonest Cercopid is *Philaenus lineatus* Linn., or the Lined Spittle Hopper, or as Osborn calls it, the Grassfeeding Froghopper. This insect belongs to the same genus as does the first mentioned and has a similar life history, but feeds upon grass, timothy and red-top. This is a European species introduced into Canada. It is remarkable in that the former species is very variable, this one is constant in its form and coloring. The male is a little smaller than the female.

Aphrophora quadrinotata Say, or the Four-spotted Spittle Insect, is also common and is often found upon grape vines. They are usually taken in the adult stage during the months of July and August.

Aphrophora parallela Say, or the Parallel Spittle Insect is found quite commonly on pine trees. In reality we should designate it the Pine Froghopper as this tree is its home. There is lives in company with *A. saratogensis* Fh. It does not show the same degree of variation as does *P. leucopthalmus*, but it varies from dark to light forms.

Lepyronia quadrangularis Say, or the Angulated Froghopper is more angular in form than the others and is fairly common. It is said to feed upon grasses, weeds and the blackberry. Little variation is seen in it.

The Genus Clastoptera has two species and they are variable.

The first is *C. obtusa* Germa. or the Alder Spittle insect. This has four varieties and is common. It feeds upon the Alder.

C. proteus has three varieties. It feeds upon the dogwood, cranberry and blueberry.

They are called hoppers because of their remarkable jumping habits. They are generally found on the boughs of trees or standing on the stalks of flowers, especially the golden rod. They are very shy and when approached they slide around to the other side and they keep out of sight.

MY EXPERIENCE THIS YEAR IN DUSTING AND SPRAYING (1919).

FATHER LEOPOLD, O.C.R., OKA, QUE.

Your kind President, Mr. Caesar, insisted that I give you a paper this year, and I thought it would interest you to know of our work at the Oka Agricultural Institute in dusting and spraying during the past season.

THE ORCHARD. The following remarks are limited to one of our orchards only, the most uniform we have to carry on a commercial experience in dusting and spraying: Our Wealthy orchard, situated on a gentle slope with a south-west exposure. It is not the best exposure for our Province, but we seem to get good results with this particular orchard.

I chose 30 rows of this orchard, as you can ascertain in looking over Table 1, so as to have a complete row of 11 trees separating each plot which number 6 in all, three plots sprayed and three plots dusted. Remember that the 6 plots are all in the same orchard, on the same site, the trees all the same age, 30 years old, and all the operations made on the same day. We could not get more uniform conditions, considering also that the bloom on each plot was quite uniform.

BLOOM. Looking over Table I, we may see that in plot I, 4 trees only out of 44, did not bloom and 23 were in full bloom; in plot II, 10 trees did not bloom and 18 were in full bloom; in plot III, 11 did not bloom and 16 were in full bloom; in plot IV, 11 also did not bloom and 11 were in full bloom, while 18 had half to three quarter of a full bloom; in plot V, only one tree did not bloom, while 21 were in full bloom; in plot VI, 4 only did not bloom and though three only were in full bloom, 15 had from one half to three quarters of a full bloom.

OBJECT OF EXPERIENCE. I insist somewhat on the fact that the greatest part of each plot had trees in bloom, as the first object I had in view, was to determine the action of liquid Lime-Sulphur on the apples in comparison with the action of liquid Bordeaux mixture on the same. I did not care what were the results as far as scab is considered, Wealthy apples not being very subject to scab.

The second object I was after was to determine just what the cost was in comparison of the dusted plots, per tree, with the sprayed plots. I have carefully gone over this in Table VIII.

I did not intend to tabulate the results of each plot separately in picking and classifying the crop, as this would have entailed too much work, for a commercial experiment. But, by going over the entire orchard, plot by plot, we had a very good idea of the results per plot.

Dusted Plots. Plots II (Table III), IV (Table V), and VI (Table VII), were dusted, with the exception of the first semi-dormant liquid spray on all except the VI's plot.

Taking up Table III we see that we used sulphur, talc and arsenate of lead in this plot, while in Table VII we see that in the last plot we substituted Hydrated Lime to the talc and arsenate of lime to the arsenate of lead and with every sort of satisfaction, thus making the last formula the most economical of all the dusted plots, as arsenate of lead is dearer than arsenate of lime.

Another interesting point was the use, for the first time in our orchards, of anhydrous Bordeaux mixture or dust Bordeaux. The arsenate of lime was used with perfect safety with this bordeaux dust. Having found the commercial copper dust too strong we reduced it by adding more hydrated lime, thus using the following formula, (Table V):

Dry Bordeaux as bought mixed already	46¼ lbs.
Hydrated Lime added to above	46¼ lbs.
Arsenate of Lime	7½ lbs.

Looking over the table of comparative costs, we can see that this new dusting material costs a little over 34½ cents per tree for the four applications, as against 33¾ cents for Sulphur-Talc-Arsenate of Lead Dusting and 17½ cents for the Sulphur-Hydrated Lime-Arsenate of Lime Dusting material

As to results on the crop, the copper dust seems to have good fungicidal value, perhaps a little better than the sulphur dusts, without any russeting to the fruit.

Sprayed Plots. I come now to the first object in view: to determine if Bordeaux mixture, as employed here in our orchards, is a superior spray than the Lime-Sulphur wash we have used since the past 10 years. In a word what the advocates of Bordeaux maintain is that Lime-Sulphur wash, far from being a beneficial spray, sprays the apples of the tree. This has not proven true at all in our orchards. In fact after we were sure that the apples in the plot sprayed with sulphur were sticking just as heavily on each tree, we had to thin each tree in plot III as in any other of the sprayed or dusted plots.

A good many visitors came to see the orchard this summer, and I may mention especially Mr. Petch, Mr. Davis and Mr. Bunting of Macdonald College. These gentlemen went over the orchard very carefully, and were convinced of the fact that Lime-Sulphur is surely a safe spray for our Province at least.

No russeting to speak of was noticed on either of the two Bordeaux mixture plots, plot I and plot V, though more Copper Sulphate was used on plot I than on plot V, the old formula of 4-4-40 being maintained on plot I and the new one of 2-10-40 on the other.

Results. Time is lacking to give too many details, but as I have mentioned before, we did not tabulate results, plot per plot, but after looking over the whole orchard, we have found that any of the formulas employed gave satisfactory results, both as to quantity and quality of the fruit. The 6 plots gave 1,500 boxes of fine apples, after they had been all thinned.

In looking over the last table of costs, dusting is certainly a more expensive way of treating an orchard than spraying; but I am going to stick to both, as both have their utility, dusting is a much quicker way to get around the trees in bad weather, and some times no results can be obtained if the applications are not made on time and thoroughly.

TABLE I.

Showing a Comparison of the Bloom in the Six Different Plots.

I.		II.		III.		IV.		V.		VI.	
1 2 3 4	5	6 7 8 9	10	11 12 13 14	15	16 17 18 19	20	21 22 23 24	25	26 27 28 29	30
¼ o o ¾		¾ o x o		o o o o		o o o ¼		x ½ ¼ x		¾ ¼ ¼ ¼	
¼ ½ ¼ ¼		x o ¼ ¾		o o o o		¼ o o ¼		x ¼ ½ ½		¼ ¼ ¼ ¼	
¼ x ½ x		¼ ¼ o o		x ½ ¼ ¼		¼ ½ ½ o		¾ ¾ x x		¼ ¼ ¼ ¼	
¾ ¼ ½ ¾		¾ ¾ x x		½ x ¼ o		o x ¾ ¾		x x x ¾		¼ ¾ ¼ ¼	
x x ¼ x		x ½ x ¾		x o ½ ¼		¾ o x ¾		¾ ¾ ¾ ¾		o ½ ¾ o	
x x x x		o x o x		x o ¼ x		x x x x		x o x x		x ¾ ¼ ¼	
x ¼ x x		¾ o x o		x x ¼ ¾		x o o ¾		x x x o		¾ ¾ ¼ o	
x x x x		¾ o x o		x ¾ x x		¾ x o x		x x ¾ x		¾ ¾ o ¼	
x x ¾ x		x x ¼ ¾		¾ ¾ x x		¾ ¾ x ¾		¾ x ¾ ¾		¾ ¾ ¼ ¼	
x x x x		x ¾ x x		x x ½ x		x ¾ ¾ ¾		¾ x x ½		x ¾ ½ x	
o ¾ o x		¾ x x x		x ¼ ¾ x		¾ ¾ ¾ ¾		¾ x ½ ¾		¾ x ¾ ¼	

Explanation of signs: o, no bloom at all; x, full bloom and the fractions mean one-fourth, one-half and three-fourths of a full bloom respectively.

Each plot contains four complete rows of trees, rows 5, 10, 15, 20, 25 and 30 separating each plot.

TABLE II.

Plot II: 39 Trees—Bordeaux Mixture, 4-4-40.

Date.	Time of Applications.	Temperature.	Material.	Quantity.	Cost Material.	Cost of Labor.	Time.
May 13.	Buds quite open	Fine	Bord. mix. 4-4-40	90 gls.	$0.92¼	0.37½	30
May 26.	Buds showing pink	Fine	Bord. mix. 4-4-40	80 gls.	0.82	0.31¼	25
June 4.	After blossoms have fallen.	Rain, night of 5 to 6, 6 to 7 and 7 to 8. Cloudy	Soluble sulphur, 1 lb. to ½ lb. Ars. Lime, Hyd. Lime, 5 lbs,	95 gls.	0.80¾	0.50	40
June 16.	Apples well formed	Fine	Same as above.	90 gls.	0.76½	0.37½	30

TABLE III.

DUSTED PLOT: SULPHUR, TALC, ARSENATE OF LEAD IN POWDER FORM—34 TREES.

Date.	Time of Application.	Temperature.	Material.	Quantity.	Cost of Material.	Cost of Labor.	Time taken.
May 15 .	Rain from night of 16 to 18 at night	Leaf buds well open	L.-S. 1.008 semi-dormant	90 gls.	0.59½	0.31¼	25 min.
May 26 .	Buds showing pink	Fine	Sulphur-Talc 60–40	80 lbs.	2.04	0.18¾	15 min.
June 4 ..	After blossoms have fallen	Rainy, nights of 5 to 7. Cloudy, 7 and 8	Sulphur of Talc. Arsenate of lead, 40–50–10	70 lbs.	3.62½	0.18¾	15 min.
June 17 .	Apples well formed	Fine	Same as above	80 lbs.	4.36	0.18¾	15 min.

N.B.—We put on a semi-dormant spray of lime-sulphur wash on the 15th of May.

TABLE IV.

SPRAYED PLOT: 32 TREES—LIME-SULPHUR-ARSENATE OF LEAD (POWDER).

Date.	Time of Application.	Temperature.	Material.	Quantity.	Cost of Material.	Cost of Labor.	Time taken.
May 16 .	Leaf buds well open	Rain from night of 16 to 18 at night	L.-S. 1.008 semi-dormant	80 gls.	0.53	0.37½	30 min.
May 26 .	Buds showing pink	Fine	L.-Sulphur, 1.007	70 gls.	0.37½	0.25	20 min.
June 4 .	Blossom having fallen	Rainy, nights of 5 to 7. Cloudy, 7 and 8	L.-Sulphur 1.007. Arsenate of lead, 1 lb. in 40	70 gls.	0.97	0.18¾	15 min.
June 16 .	Apples well formed	Fine	L.-S. 1.006, ½ lb. ars. of lead	80 gls.	0.42	0.25	20 min.

TABLE V.

DUSTED PLOT: ANHYDROUS BORDEAUX AND DRY ARSENATE OF CALCIUM.

Date.	Time of Application.	Temperature.	Material.	Quantity.	Cost of Material.	Cost of Labor.	Time taken.
May 16 .	Leaf buds well open	Rain from night of 16 to 18 at night	L.-S. 1.008	80 lbs.	0.53	0.37½	30 min.
May 26 .	Buds showing pink	Fine	Bordeaux dust, at 2½% metallic copper	80 lbs.	3.20	0.31¼	25 min.
June 4 .	Blossoms having fallen	Rainy nights of 5 to 7. Cloudy, 7 and 8	Dry Bordeaux, 46¼ lbs. Hydrated Lime, 46¼ Ars. Lime, 7½ lbs.	70 lbs.	3.15	0.31	25 min.
June 17 .	Apples well formed	Fine	Same formula as on June 4th	65 lbs.	2.92½	0.25	20 min.

TABLE VI.

SPRAYED PLOT: BORDEAUX MIXTURE 2-10-40 AND SOLUBLE SULPHUR—41 TREES.

Date.	Time of Application.	Weather.	Material.	Quantity.	Cost of Material.	Cost of Labor.	Time taken.
May 16 .	Leaf buds well open	Rain from nights of 16 to 18	Lime-Sul. semi-dorm., 1.008	90 gls.	0.59½	0.43¼	35 min.
May 28 .	Buds showing pink	Fine	B. mixture, 2–10–40. 2 lbs. $CuSo_4$	80 gls.	0.53	0.31¾	25 min.
June 4 .	Blossoms having fallen	Rain nights of 5 to 7. Cloudy, on 7 and 8	1 lb. solution sulphur; ½ lb. ars. of lime to 40 gls.; 5 lbs. H.L.	90 gls.	0.48	0.27½	20 min
June 16 .	Apples well formed	Fine	Same as above, ex. 1 lb. ars. lime	75 gls.	1.01¾	0.27½	20 min.

Do not use arsenate of lead with soluble sulphur. Be sure to add the hydrated lime (H.L.) to the soluble sulphur ars. of lime combination.

TABLE VII.

Dusted Plot: Sulphur, Hydrated Lime, Arsenate of Lime—38 Trees.
There is no semi-dormant spray in this plot. The Oka formula for dusting.

Date.	Time of Application.	Weather.	Material.	Quantity.	Cost of Material.	Cost of Labor.	Time needed.
May 26.	Buds showing pink	Fine	Sulphur and Hydrated Lime, 60–40	80 lbs.	2.08	0.25	20 min.
June 4.	Blossoms having fallen	Rain, nights of 5 to 6. Cloudy, 7 to 8	15 lbs. Sulphur, 5 lbs. Ars. Lime, 80 lbs. Hyd. Lime	75 lbs.	1.90¼	0.25	20 min.
June 17.	Apples well formed	Fine	Same formula as on 4th of June	80 lbs.	2.02½	0.18¾	15 min.

We have found the above dusting formulas, omitting the semi-dormant spray in Quebec, to be the most economical dusting sprays.

TABLE VIII.

A Comparison of the Cost of the Dusted and Sprayed Plots.

Plot.	Material.	Labor.	Total Number.	Trees.	Cost per Tree.
I	$ 3.31¾	$1.56¾	$ 4.87¾	39	$0.12½
II	10.61	0.87½	11.48½	34	0.3378
III	2.29½	0.06¼	3.35¾	32	0.1049
IV	9.80½	1.25	11.05½	32	0.3454
V	2.62¼	1.30½	3.92¾	41	0.0957
VI	6.00¾	0.68¾	6.69½	38	0.1762

INSECT OUTBREAKS AND THEIR CAUSES.

JOHN D. TOTHILL, FREDERICTON, N.B.

The Standard Dictionary defines an outbreak as "a sudden and violent breaking forth as of something that has been pent up or restrained." This definition seems peculiarly apt for describing the biological meaning of the word because it implies that all nature is in a condition of restraint and that an outbreak is something abnormal due to the breaking of one or more restraining bonds.

Outbreaks are not confined to species of the insect world and neither are they confined to the animal kingdom. In the vegetable kingdom for instance, there are the familiar cases of the Russian thistle in Western Canada and the California Prickly Pear in Australia. There is also in our own country the case of the Northern Scrub Pine that so often comes up in pure stands after a fire has swept away the original soft wood forest. In the animal kingdom we have among insects such familar cases as the European Gipsy Moth in the New England States, the Forest Tent Caterpillars that greased the tracks and stopped some trains in Canada in 1914; the Army-Worms that at times have spoiled the Western wheat crop; and periodical outbreaks of short-horned grasshoppers. Examples of outbreaks of various species of vertebrates are also quite plentiful; there is the historical case of the European Cotton-tail Rabbit in Australia and there is the present case of the little prairie dog in Alberta. Even man himself has been known to be in a condition of biological outbreak; Caucasian Man in the 17th and 18th centuries doubled his population every twenty-five years on the North American Continent. So that outbreaks of general occurrence may be met with almost anywhere in the realm of living things.

To what causes are these outbreaks due?

As each species is held in equilibrium by the pressures of its environment it is obvious that an outbreak is due to a relaxing of one or more of these pressures.

Let us examine the cases of a few insect outbreaks the causes of which have been studied.

During the first twenty-five years of the Oyster Shell Scale's regime on this continent it increased so abundantly that men like Fitch held fears for the development of an apple industry. With the passage of the time, however, the menace of this scale insect has subsided. In the light of studies made on the present environmental conditions of this insect in Canada it seems probable that the early outbreak was due to an absence of its most effective enemy, a predaceous mite.

Turning to the Gipsy Moth I think we are more or less agreed that the New England outbreak was due more especially to an absence of natural enemies, such as the handsome Calosoma of Europe and the efficient little two-winged fly Compsilura; and also perhaps to a partial release of the food pressure.

In some of our Maritime Province cities there was last year an outbreak of the White-Marked Tussock. Mr. Dustan, who was detailed to make a study of these outbreaks, found that they were due largely to an abundant food supply; to an absence in cities of chickadees and the larger species of woodland ants; and to a relative scarcity of parasitic insects.

There is, at the present time, an outbreak of the Forest Tent insect in Alberta. Studies by Mr. Baird and myself have shown that the outbreak is due at least partially to an almost total absence of its usual insect parasites. It is also influenced perhaps by a relaxing of the food pressure or, in other words, to an increased proportion of trembling poplar.

In New Brunswick our last outbreak of the Forest Tent insect subsided suddenly in 1915. The outbreak seems to have been due to an over abundance of the poplar supply, as a direct result of civilization and forest fires.

In the case of the Spruce Budworm a study of the New Brunswick outbreak has shown the fundamental cause to be a relaxing of the normal food pressure in the form of an increased supply of balsam fir, which is the favored food plant.

This relaxing of the food pressure has been brought about by the hand of man and has been an inevitable result of existing lumbering practices.

Without going into details it can be said that the increase of balsam fir has not only meant an increased food supply, but has also meant a decreased bird supply. For the birds that under conditions of the primeval mixed type of growth keep this insect properly subdued, seldom nest or feed in pure stands of balsam fir.

In New Brunswick we now have an incipient outbreak of the Fall Webworm, and as our studies on this insect have been carried through the best part of a decade, it may be of interest to examine this case a little more closely than the others. In order to show the causes of the present outbreak let us glance for a moment at the situation obtaining toward the end of the last outbreak, and then let us follow the situation through a short term of years until the insect became almost extinct in the Province, and finally let us glance at the conditions of the present incipient outbreak.

In 1912 the Fall Webworm was abundant in New Brunswick and from the fact that the environmental pressures were then in a very nice state of equilibrium I infer that the insect had been a fairly conspicuous member of the fauna for at least a decade.

The food pressure was not very great because the staple diet is Alder and there is an abundance of this shrub along our streams and waterways; the food supply is not great enough to produce menacing millions of the insects but it is sufficient for their maintenance in a condition of mild outbreak.

On the basis of an average egg mass of 260 eggs, there were about 26 that for some reason or other failed to hatch. Of the 234 that did hatch about 42 were attacked in the young caterpillar stage by a four-winged parasite called *Apanteles*. Of the 192 left to tell the tale about 6 were attacked by another little four-winged fly *Meteorus*. Then as the larvæ grew in stature about 22 of those surviving fell prey to a fair-sized Ichneumon that is now known as a *Campoplex*. In spite of these attacks by insect parasites there were still left about 164 half-grown caterpillars. Of these about 85 were parasitized and so removed from the contest by another species of *Campoplex*. The 79 remaining larvæ became about three parts grown when a two-winged fly *Varichaeta* began an attack upon them. This fly victimised about 45 and this attack together with that of another species of minor importance reduced the inmates of our average nest to about 32. About this time the young red-eyed vireos were getting very hungry and the webworm caterpillars fell a prey to them. Of the 32 remaining these birds devoured over 90 per cent. leaving only about two in each nest. The few not attacked by birds were able to pupate, but some of them fell victims to pupal parasites of which an *Exochilum* was the most effective.

As a result of the combined environmental pressures the average number of moths yielded by each egg mass was less than two, so that in the following year there was a measurable decrease in the numbers of the webworm.

This decrease continued very regularly year after year until 1916 when the insect became almost extinct in the Province.

It is interesting to note in passing that as the species became less and less abundant the environmental pressures became so great that it was threatened with extinction. It may also be noted that as the species became rare so did its parasites until finally the red-eyed Vireos were averaging a spoil of 198 caterpillars from each web.

When the Webworm had practically disappeared from the entire Province, as represented by nine observation points, something happened that changed the whole situation. A flight of moths was blown across the Bay of Fundy and the coastal belt from St. John to Moncton was heavily seeded with the insects.

This condition enabled the species to do battle once more on favorable terms with the Vireos, and it began to increase and spread out again over the Province. It has now spread out over more than half the Province and is gaining ground rapidly.

The gain in numbers is also greatly favored because the parasites died out as the host became rare and they have not yet returned to the feast. Moreover they are not likely to return until our present outbreak becomes linked up with territory in which they now occur.

In a word then the causes of our present outbreak are, first an elimination of parasites from New Brunswick, then a flight of moths from new territory.

Having now considered a few insect outbreaks and their causes it may be remarked by way of conclusion that civilization is directly responsible for many of our more notorious outbreaks. We are increasing the food supply of particular insects and thereby making conditions favorable for outbreaks. This is not only true for the insects attacking agricultural crops but is also true for some of our forest insects. In New Brunswick we now have many square miles of forest lands supporting pure stands of poplar and these areas are the nursing grounds of our all too numerous forest tent caterpillar outbreaks. The pure stands of poplar have come in after the fires of civilization have swept away the ancient mixed growth. We also have many square miles of forest now composed of pure stands of balsam fir. In these stands has been nursed the present outbreak of Spruce Budworm—an outbreak that has swept away about three-fourths of the entire crop of merchantable fir in the Province. The overproduction of fir, as already pointed out, is a direct and necessary result of the existing methods of lumbering. In the cases of the Forest Tent insect and the Spruce Budworm civilization has had the effect of removing one of the most powerful of the restraining bonds, namely, that which under natural conditions constitutes a food pressure.

FURTHER NOTES ON THE CONTROL OF PEAR PSYLLA.

W. A. Ross and W. Robinson, Dominion Entomological Laboratory, Vineland Station, Ontario.

With a view of securing some definite data on the susceptibility to common contact insecticides of pear psylla eggs at different stages of incubation, and in order to ascertain what spray material is the most effective ovicide, the following preliminary experiments were conducted this past year (1919).

Experiments Under Greenhouse Conditions.

During the latter part of the winter adult psyllas were taken from their hibernating quarters in the orchards and were brought into the greenhouse. There

they were placed on small pear trees—French seedlings—grown in flower pots and were then confined by means of lantern globes. The insects mated readily and deposited their eggs on the seedlings. Large numbers of eggs of known age were in this way readily secured.

PERIOD OF INCUBATION. The duration of incubation of the egg was obtained from the "check" experiments, which will be referred to later, and was found to vary to no considerable extent under the fairly uniform greenhouse temperatures. In fourteen out of sixteen experiments it varied from nine to eleven days. The exceptional periods of incubation were respectively eight days and twelve days.

EXPERIMENTS WITH CONTACT INSECTICIDES.

Batches of eggs, at different stages of development from newly-laid to those on the point of hatching, were sprayed by means of an atomizer with four different dilutions of lime-sulphur wash; soluble sulphur and hydrated lime; lime-sulphur and starch; and lime-sulphur and Black Leaf 40. The results were as follows:

LIME-SULPHUR WASH.

TABLE I—EFFECT OF LIME-SULPHUR, 1-10, 1.027 SP. GR. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
2	557	Newly laid	64	70.0
2	470	4 days old	74	67.2
3	466	8 ,, ,,	67	68.8
1	414	*9 ,, ,,	74	73.4
Total.. 8	1,907			

TABLE II—EFFECT OF LIME-SULPHUR, 1-9, 1.029, SP. GR. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
6	843	Newly laid	89	91.3
8	730	4 days old	79	78.6
6	744	8 ,, ,,	77	75.5
2	282	*9 ,, ,,	43	32.3
Total.. 22	2,599			

TABLE III—EFFECT OF LIME-SULPHUR, 1-8, 1.032 SP. GR. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
10	679	Newly laid	99	99.7
9	593	4 days old	95	99.1
6	609	8 ,, ,,	99	99.3
5	848	9–10 ,, ,,	93	92.1
Total.. 30	2,729			

TABLE IV—EFFECT OF LIME-SULPHUR, 1-7, 1.037 SP. GR. ON PSYLLA EGGS.

No. of tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
2	636	8 days old	100	100
2	635	*9–10 ,, ,,	100	100
Total.. 4	1,271			

* On the Point of Hatching.

As shown in the foregoing tables, lime-sulphur is most effective as an ovicide when used at the strength of 1-7. The tables also show that the newly-laid eggs are on the whole more readily destroyed than those on the point of hatching.

In the experiments with lime-sulphur 1-8 and 1-9 it was observed that frequently a large percentage of the eggs would hatch. However, the spraying mixtures apparently had weakened the embryos or nymphs within the eggs to such an extent that in emerging or immediately after emerging they succumbed.

In the tests where lime-sulphur 1-7 was used 100 per cent. of the eggs invariably collapsed.

LIME-SULPHUR AND STARCH.

An effort to increase the ovicidal value of the weaker lime-sulphur sprays by adding starch to them in order to make them spread and stick better met with success. (See Tables Nos. 5, 6, 7.)

TABLE V—EFFECT OF LIME-SULPHUR 1-10 PLUS 2 LBS. STARCH TO 40 GALS. ON PSYLLA EGGS.

No. of Tests. made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
*1	364	Newly laid	100	100
2	392	4 days old	100	100
2	577	8 ,, ,,	100	100
2	438	9–10 ,, ,,	100	100
Total.. 7	1,771			

TABLE VI—EFFECT OF LIME-SULPHUR 1-9 PLUS 2 LBS. STARCH TO 40 GALS. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
4	588	Newly laid	100	100
*4	471	4 days old	100	100
2	251	8 ,, ,,	100	100
4	581	9–10 ,, ,,	100	100
Total.. 14	1,891			

TABLE VII—EFFECT OF LIME-SULPHUR 1-8 PLUS 2 LBS. STARCH TO 40 GALS. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
5	615	8 days old	99	99.6
*5	867	9–10 ,, ,,	100	100
Total.. 10	1,482			

* In some of the tests a small percentage of eggs hatched, but the nymphs, in the process of emerging or just after emerging, succumbed.

LIME-SULPHUR AND BLACK LEAF 40.

A combination of lime-sulphur 1-9 and Black Leaf 40 also proved 100 per cent. effective.

TABLE VIII—EFFECT OF LIME-SULPHUR 1-9 PLUS BLACK LEAF 40, ⅜ PT. TO 40 GALS. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were treated.	Average per cent. killed.	Actual per cent. killed.
2	435	Newly laid	100	100
*1	540	4 days old	100	100
*1	558	8 ,, ,,	100	100
1	485	9 ,, ,,	100	100
Total.. 5	2,018			

* In these cases a small percentage of eggs hatched, but the nymphs, in the process of emerging or just after emerging, succumbed.

SOLUBLE SULPHUR AND HYDRATED LIME.

In using soluble sulphur, hydrated lime was added to the spray primarily to prevent injury to the bursting buds.

TABLE IX—EFFECT OF SOLUBLE SULPHUR, 12½ LBS., HYDRATED LIME, 10 LBS., TO 40 GALS. ON PSYLLA EGGS.

No. of Tests made.	Total No. of Eggs.	Stage of Incubation when eggs were laid.	Average per cent. killed.	Actual per cent. killed.
3	796	Newly laid	100	100
2	700	4 days old	100	100
2	845	8 ,, ,,	100	100
2	500	9 ,, ,,	100	100
Total.. 9	2,841			

CHECKS. Sixteen batches of eggs were left untreated at various times while the foregoing experiments were being conducted. These served as checks. Out of a total of 1,346 eggs, 93 per cent. hatched.

EFFECTS ON NYMPHS. The few tests which were made with lime-sulphur, etc., on recently hatched nymphs were sufficient to show that 1st and 2nd instar nymphs are readily destroyed by lime-sulphur 1-8 and 1-9, with or without starch.

TABLE X—EFFECT OF SPRAY MIXTURES ON RECENTLY HATCHED PSYLLA NYMPHS.

Treatment.	No. of Tests made.	Total No. of Nymphs.	Instar.	Average per cent. killed.	Actual per cent. killed.
Lime-Sulphur, 1-8	2	47	1st	100	100
	2	107	2nd	100	100
Lime-Sulphur, 1-9	3	371	1st	98	95.2
	2	88	2nd	100	100
Lime-Sulphur, 1-9 Starch, 2 lbs. to 40	1	85	1st	100	100
Lime-Sulphur, 1-10	1	85	1st	91	91
Lime-Sulphur, 1 to 10 Starch, 2 lbs. to 40	1	271	1st	96	96
Total	12	1,054			

ORCHARD EXPERIMENTS.

S. M. CULP'S ORCHARD. Our orchard experiments on the control of psylla were conducted at Beamsville in S. M. Culp's thirteen-acre orchard of Bartlett, Duchess, Kieffer, Flemish Beauty, Bosc, Winter Nelis and Anjou pears. The mild winter of 1918-19 was very favorable for the hibernating adults and in the spring they emerged in large numbers and a large deposition of eggs was made.

FIRST APPLICATION. The first application, i.e. the application to destroy the eggs, was put on by means of a spray gun at the usual time,* and the following spray mixtures were used:

(1)	Lime-sulphur	1-7
	Lime-sulphur	1-9
(2)	Starch	2 lbs. to 40 gallons
(3)	Lime-sulphur	1-10
	Starch	2 lbs. to 40 gallons
(4)	Soluble sulphur	12½ lbs.
	Hydrated lime	10 lbs.
	Water	40 gals.

No one spray mixture, so far as we could judge, proved superior to the others. Each destroyed practically all the eggs and exposed nymphs. The nymphs which had hatched out before the sprays were applied and had sought shelter in the leaf buds beneath the bud scales were uninjured. These averaged about 1.5 to a leaf-bud on all varieties other than Kieffer. On the Kieffer trees the infestation was about .18 to a leaf cluster. This difference no doubt was due to the fact that the Kieffer trees were out in leaf when the spray was applied and therefore did not afford the nymphs much protection.

* The Pear Psylla in Ontario—Report of the Ent. Soc. of Ont., 1918, pp. 81-90.

All the spraying mixtures injured the buds and foliage to a slight but not appreciable extent. In comparing the Culp orchard with pear trees which had been sprayed with lime-sulphur 1-20, no difference in the amount of "burning" was noticed.

SPRAYING FOR THE NYMPHS. In order to destroy the nymphs which had escaped the first spray and those which had hatched from the eggs of belated females, a second application was made after the blossoms fell. Black Leaf 40, 3/8 pint to 40 gallons, was added to the regular codling moth spray (Lime-sulphur 1-40, arsenate of lead 2½ lbs. to 40) and this was applied with great thoroughness.

This application gave excellent results. When the orchard was examined a few days later only an old psylla was found. The insect increased very slowly in numbers throughout the season and right up to early September its numbers were very insignificant. The foliage was in beautiful condition all season and the trees bore an excellent crop of pears.

W. F. W. FISHER'S ORCHARD. Part of a large pear orchard at Burlington was sprayed at the usual time for the "egg spray," with lime-sulphur wash 1-9 and starch 2 lbs. to 40 gallons and the other and smaller part was sprayed with lime-sulphur 1-7. In addition to this all the trees received the post-blossom application of Black Leaf 40.

RESULTS. Excellent results were secured—the psylla was reduced to very insignificant proportions, and for the first time in many years caused no damage.

EVENING SESSION.

The Evening Meeting was held at 8 p.m. in the Carnegie Library and was well attended by members and others interested. The chair was occupied by the Deputy Minister of Agriculture, Mr. J. H. Grisdale. The Popular Address was given by Mr. C. L. Marlatt, Chairman of the Federal Horticultural Board, Washington, D.C., his subject being "The Federal Plant Quarantine Act" or "How the United States is Preventing the Introduction of Foreign Insect Pests and Plant Diseases." The address was highly appreciated and felt to be of special value to Canadian Entomologists, as was pointed out by the President of the Society, Prof. Lawson Caesar, while proposing a vote of thanks.

THE FEDERAL PLANT QUARANTINE ACT.

C. L. MARLATT, CHAIRMAN, FEDERAL HORTICULTURAL BOARD, WASHINGTON, D.C.

[The following discussion covers the subject in a general way as it was presented extemporaneously.]

Most of you undoubtedly are familiar with the Federal Plant Quarantine Act and with the general features of its administration through a Federal Horticultural Board. This Act was the outcome of a long, hard fight which began twenty years ago as a result of a nation-wide conference called in Washington. This conference included state entomologists and inspectors and secretaries of agriculture and horticulture and other persons interested in plant protection. The need of a federal quarantine which should give protection to the whole United

States had long been felt. The San José Scale excitement of that period was, however, the leading element in bringing about the demand for a federal plant law. As a result of the conference in Washington a broad plant law was drafted which was intended to regulate both foreign importation of plants and also interstate traffic. On account of its breadth of field this proposed law aroused a good deal of opposition and failed to get any real standing before Congress. It was re-introduced at different sessions of Congress for a number of years but never received effective support

In 1908 and 1909 the plant import situation became very serious on account of the sudden increase of infestation of nursery stock received from Europe and Japan by gipsy and brown-tail moths. This was about eight years after the original attempt to get federal plant quarantine law. The failure up to that time to get Congress to act had rather dispelled the enthusiasm of most of us, and the passage of any satisfactory law through Congress was generally looked upon as being practically impossible. The securing of legislation, giving new federal powers, is always a difficult matter and especially so where such powers involve an entirely new subject of legislation encroaching in any degree on the police or other powers of the states.

In the face of the great danger which this country was under from the character of nursery stock importations of 1908-09 I secured permission from the Secretary of Agriculture to draft a new plant quarantine law and to have it introduced in Congress. That draft was the original of the present plant quarantine act. It was a very difficult matter to get this legislation through Congress. The bill was revised and re-introduced many times before it was finally passed in August, 1912, and the story of the long fight to get this legislation would be a very interesting one if I had time to relate it.

The Federal Plant Quarantine Act of 1912 is limited to control of entry of foreign plants and plant products, and to the establishment of domestic quarantines within the United States controlling interstate movement of such quarantined or restricted plants or plant products. As to its foreign features, all plants or plant products of whatever kind are subject to restriction. As to the domestic and interstate features, not only plants and plant products may be restricted but any other article which may be the means of conveying insect or disease enemies of plants, a control broad enough to cover, for example, stone and other quarry products, earth, or even manufactured articles. The law does not provide for any general interstate control of plant traffic except in relation to specific quarantines to prevent the spread of dangerous insects or plant diseases, and in this respect is less broad than the law drafted by the original conference at Washington referred to at the outset of this discussion.

This quarantine act has now been in force seven years. There are now in force under it some fifteen foreign quarantines and seven orders restricting or regulating the entry of plants and plant products and some twelve domestic quarantines. With most of this quarantine and control action you are doubtless fairly familiar. I will discuss rather briefly a few of the more important activities of the Board in respect to these quarantines and restrictions on plant movement.

Perhaps the most important activity of the Board at the moment is in relation to the pink bollworm of cotton. This insect is a very important new enemy of cotton which has recently obtained foothold in Mexico and also scant foothold in Texas. To prevent the further entry of this insect into the United States and to effect its control in the limited areas where it is now established we are now

receiving from Congress an annual appropriation of upwards of half a million dollars. The work involved covers a very wide range, including extensive clean-up operations in Texas, the enforcement of a quarantine service between Mexico and the United States, the control of all import cotton into the United States and of the cotton mills in this country which make use of such import cotton, and also the control of cottonseed cake and meal and any other product relating to cotton which may be a means of introducing the insect.

Another important quarantine feature under the Board is the white pine blister rust quarantine, which has for its special object the protection of the great pine areas of the western half of the United States from infestation from the eastern half of the United States where this disease has gained wide and probably firm foothold.

One of the later quarantines has relation to the European borer which has recently obtained foothold in the neighborhood of Boston and in a limited area near Albany, N. Y. We are asking Congress for an appropriation of $500,000 for quarantine and other control work in relation to this borer. Inasmuch as this insect is known to infest practically all succulent vegetation, even grasses, and is so concealed as to make its discovery difficult, its extermination is recognized as an impossibility, but if it cannot be exterminated, it certainly can be controlled. I do not believe in being unnecessarily alarmed over the introduction of any new pest, and in the case of this new corn borer, the last year's experience has demonstrated that there are at least four important controlling factors which may later on show this pest to be a comparatively unimportant one, certainly indicating that Canada, for example, need have very little fear on account of it. These hopeful or controlling factors are: (1) for the northern areas of corn culture, single-broodedness with accompanying negligible damage indicated; (2) possibility of cultural control by the elimination of weeds; (3) the immunity now indicated for ordinary field corn, and (4) the possibility of effective egg parasitism.

(The introduction of this insect through the agency of imported broom corn and its probable wide dissemination in the United States was discussed in some detail.)

Another problem that has recently come up to the Board is the potato wart disease, one of the three plant enemies specifically mentioned in the Federal Quarantine Act to be immediately guarded against. This disease was evidently brought into this country in the winter and spring of 1911-12 before the Quarantine Act was passed. The Department of Agriculture through the Federal Horticultural Board is co-operating with the State of Pennsylvania in a thoroughgoing campaign to eradicate this pest. The work of the last season, now concluded, has presented a very much more hopeful outlook also with respect to this potato disease. In other words, the principal commercial varieties of potatoes grown in the United States have developed a substantial immunity to this disease and it looks very possible, therefore, that it can be controlled through the growth of these immune varieties and other varieties, the immunity of which has already been demonstrated in European countries.

These are a few of the important subjects which the Board now has under way. Other subjects are the Oriental fruit or peach moth which came from Japan on ornamental cherry stock and has obtained rather wide foothold in the District of Columbia, Maryland and Virginia and also in New York and a few other places. This pest might have come to this country on any shipment of Japanese ornamental cherry or peach stock, but apparently obtained its first foothold through a ship-

ment of cherry trees made as a gift of the City of Tokio of Japan to the City of Washington. The first lot was of large sized trees and so seriously infested with various insects that the trees were burned. A second sending was later made of young trees and these were apparently in a fairly healthy condition and at least had been so pruned back that any evidences of the work of this insect had been entirely removed. Incidentally, it may be said that it is a very difficult matter to detect an insect about which you know nothing and which you are not anticipating. The inspector does not know where to look for it. In the case of this pest, even with full knowledge of its habits, it is a very difficult insect to detect by inspection, so carefully concealed is it in its hibernating situation. This infestation was not discovered at the time and the trees were planted in Washington's Riverside Park. The local infestation of the District of Columbia and adjacent Maryland and Virginia has undoubtedly originated from this importation of flowering Japanese cherries. The incident illustrates the futility of inspection, even when carefully conducted, as a means of detecting unknown or unfamiliar pests and is one of the strong arguments for the more radical quarantine action which the Board has recently taken in respect to all such ornamental and nursery stock.

Another pest recently imported is the so-called Japanese beetle. It was introduced apparently about eight years ago on iris stock imported by the Dreer nurseries. It now has a very strong foothold in a comparatively small area in New Jersey opposite Philadelphia. This insect lives nine months of the year in the ground out of sight, is a strong flier, feeds miscellaneously on all sorts of vegetation, and there is therefore very little likelihood that it can ever be exterminated. By federal and state appropriation, however, a strong effort is being made to control this insect and to demonstrate the possibilities of exterminating it if such possibilities exist.

One of the last, and perhaps one of the worst, plant pests that has turned up in this country is the "take-all" disease of wheat which has recently been determined in a few fields in southern Illinois and in a similarly small area in Indiana. War conditions and food shortage led to a movement looking to the importation of wheat from Australia into the United States to replace American-grown wheat which was being exported to meet European needs. A knowledge of the risk from such Australian wheat led the Board to declare a federal quarantine and to place such restrictions as to disinfection and use of such wheat as to safeguard its entry. While these steps were in progress this disease was discovered in a small area in southern Illinois and later in a small area in Indiana. The method of entry of this disease is unknown and nothing has been found to indicate that it came with any wheat imported from Australia for commercial purposes. It is probable that its entry was due to some experimental importation of Australian wheat. Very energetic action was undertaken in co-operation with the two states concerned to stamp out the disease in the infected areas, including the prohibition of the further growth of wheat in such areas and the disinfection of the grain and the burning of infected straw and stubble.

These seven or eight quarantine subjects which I have mentioned, together with the nursery stock quarantine, are the big items of work which the Federal Horticultural Board has under way at the present time.

I will close with a brief discussion of the nursery stock, seed and plant quarantine, a subject which has perhaps as great interest for you as any of these others and is one of the oldest of our lines of work. This quarantine has been adminis-

tered since the passage of the Act in 1912, but has been revised under what is known as Quarantine No. 37. For seven years the Board had been endeavoring to prevent the entry of pests with imported nursery stock and other plants and seeds by a system of foreign inspection and certification with re-inspection of imported goods at destination in this country. Under this system all foreign countries wishing to engage in plant traffic with the United States on a commercial scale have been required to establish an adequate inspection and certification service. Practically all of the important countries of the world have now established such service in response to the demands of the plant quarantine act of the United States. The benefit of this service, as evidenced in the character of the plant shipments to this country, has been tremendous. Whereas, before these inspection and certification measures were compelled by our act, thousands of instances of browntail moth and gipsy moth infestations occurred in a single year in our plant imports, there are now comparatively few instances of these pests being found. Freedom from all kinds of insect pests and plant diseases has been very marked as compared with the old conditions, but, after all, it is only a *marked* improvement, not absolute freedom. These pests still come in. For example, sixty-three instances of browntail and gipsy moth infestations have been discovered by the inspection service in the seven years since the act went into effect, and it is unfortunately not at all certain that all infestations by these insects were discovered in re-inspection at destination in this country. Hundreds of other pests have also been discovered as a result of these inspections. This state of affairs was the important reason leading to the enactment of a new nursery stock, plant and seed quarantine, namely, Quarantine Order No. 37. Before this quarantine was promulgated the subject was given long and careful consideration. A thoroughgoing investigation was inaugurated by the Board, bringing into its scope all the departmental plant experts of its various bureaus. The matter had also been under consideration for several years by state men through their organizations. Finally the whole subject was discussed fully at a hearing at which the producing horticulturists and the state experts of the whole country were brought together. This discussion indicated a practically unanimous support of a quarantine which had been outlined and which was substantially the same in scope as Quarantine No. 37.

Following this hearing the matter was given further study by our experts and some of these experts visited producing horticultural establishments of this country to discuss the needs of this country as to plant importations. Some months later a final conference was called of all the interests concerned and to this conference was submitted a provisional draft of the quarantine. It was eight months after the quarantine had been first broached that it was finally promulgated. The action of the department and the Board, therefore, can certainly not be charged with having been precipitant. The quarantine became effective June 1st, 1919. It has aroused a wide criticism and protest, much of this protest being based on misrepresentation. It has been represented, for example, that the quarantine will prevent the entry into the United States of new plant creations of Europe and other foreign countries and that America will be forever deprived of all such additions to its horticulture and floriculture. There is no foundation for this charge. The quarantine does not really prevent the importation of any plants into the United Satates for which a real need can be shown. Provision is made in the quarantine for the entry for introduction purposes of any new plant creations of Europe or other foreign countries. Furthermore, the quarantine provides for the entry of any reasonable amount of plant material not available in the United

States which is needed for the development of reproduction enterprises to supply home needs. All such special introductions, however, must be made through the Department of Agriculture and will be subject to all the safeguards which the highly developed inspection service of the Department in Washington can give, including, if necessary, detention in quarantine or even the destruction of the imported material if its condition of infestation is such that such destruction is determined as necessary to prevent entry of pests or plant diseases. It is not probable, however, that material offered for entry under this provision of the quarantine will be often so infested as to require such drastic action. As a result of the misrepresentation referred to and other phases of misrepresentation Congress and the Department of Agriculture at Washington have been flooded with letters and petitions in opposition to the quarantine. This opposition has largely come from certain importing interests which will be necessarily restricted in business by the quarantine.

The experts of the Department of Agriculture, and, I think, also the thoughtful horticultural interests of the country, are convinced of the need of such quarantine action. Undoubtedly this quarantine will lead to a development in this country of horticultural productions to take the place of the articles which have hitherto been obtained from foreign sources. In this way it will indirectly be the means of developing American horticulture and floriculture. It is only fair to say to those who go into production enterprises to supply the material the importation of which has been cut off that this quarantine in all probability in its main lines will stand and that such enterprises will therefore fill a permanent place in our horticulture. This does not mean that Quarantine No. 37 is not subject to modification or change, but it does mean that the department and the experts of the country are convinced that it is sound in principle and that its enforcement practically along its present lines will afford a needed protection for the forest, fruit and farm interests of this country. Wherever an error can be shown it will be corrected but changes will not be made for personal, selfish, or commercial interests, however powerful their backing, to the loss of the principle of protection which underlies and is the basis for this quarantine.

HOPKINS' BIOCLIMATIC LAW.

Wm. Lochhead, Macdonald College, Que.

Economic Entomology is ever drawing on other sciences for aid in the solution of its problems. It is indebted to chemistry for help in solving the problem of insecticides, to bacteriology and botany in the effort to work out means of controlling certain insects by bacteria and fungi, to agriculture for the introduction of farm practices that tend to control certain insects, to zoology for a knowledge of the habits of birds and other animals that feed upon insects; to physics for suggestions and explanations regarding the construction of many useful devices, and to Meteorology for the help it has given toward a better understanding of the distribution of organic life and of the factors that influence its seasonal activities. Without a knowledge of these sciences an economic entomologist may make but little headway when brought face to face with a new practical problem.

One of the most recent and most far-reaching contributions to Economic Entomology is the Bioclimatic Law of Dr. Hopkins of the U. S. Bureau of Entomology.

THE SCIENCE OF PHENOLOGY. From time immemorial agricultural practice has been guided by meteorological factors. Primitive man, no doubt, soon discovered that his food plants required a limited period to reach maturity and that every growing season had its earliest and latest dates for planting. He soon learned, too, that these dates varied with different regions, with different seasons, and with local weather conditions. In the course of time a mass of observations accumulated, which constituted the basis of farm practice. Naturally much error crept into the observations and false deductions were drawn from certain coincidences, but on the whole the early growers of plants were guided by experience. Their contact with nature was very intimate, perhaps more intimate than that of the farmers of to-day. They knew the times of opening of the buds of the various shrubs and trees, and of the arrival and departure of the birds, and learned to associate certain farm practices with these events as natural guides.

For example, the time of the appearance of the blossoms on the maple was considered by many people a suitable time to begin gardening; the blossoming of blackberries the best time for bean planting; the blooming of the locust trees for the planting of cotton; the mouse-ear size of white oak or maple leaves for the planting of corn; the opening of the elder flowers for the sowing of turnip seed; the ripening of the elder berries for the harvesting of the early onions; and the ripening of the burs of the small cockle-bur for the harvesting of the late crops. In other words, the early farmers associated their farming operations with periodic phenomena connected with some tree, shrub or plant.

In the eighteenth century when plants began to be studied scientifically attention was given to the recording of observations on such periodic phenomena as the opening of the buds, the time of flowering, the ripening of the seeds, etc., which give rise to the science of phenology. At the same time studies were made to determine the geographical distribution of plants and animals.

In the course of these investigations the rates of variation in the dates were partially determined for different latitude, longitude and altitude, but the number of data was not sufficient to permit a definite law of variation to be formulated.

It was early observed that while temperature was the main controlling factor in bringing about variations in periodic phenomena other factors also played an important part. Dr. Merriam's maps of the zonal distribution of plants and animals into Life Zones were largely based on the temperature factor and are very suggestive and helpful in matters of life distribution. These maps, however, do not furnish information regarding the dates of periodic phenomena in different regions and districts so much desired by the economic biologist in the matter of application of methods of control in the different regions.

As an example, the old spraying calendars, based on regional distribution rather than phenological phenomena, have been discarded as unsatisfactory, and instead "some periodic event in the plant to which the spray is to be applied is given as the index to the time to do the work."

Dr. A. D. Hopkins was the first person in America, I believe, who attempted to apply this science of phenology to the solution of entomological problems, especially those relating to certain forest insects in West Virginia. Later it was applied in connection with the control of the Hessian Fly, and as an outcome of the investigations a definite Bioclimatic Law was formulated, which forms a working guide for farm practice and biological research over the entire continent. In connection with this law Dr. Hopkins has prepared a system of maps and com-

Fig. 1. Isophanal Map of the United States in 1 degree isophanes and 1 x 5 degree quadrangles to illustrate method of expressing the geographical constants of the Law.

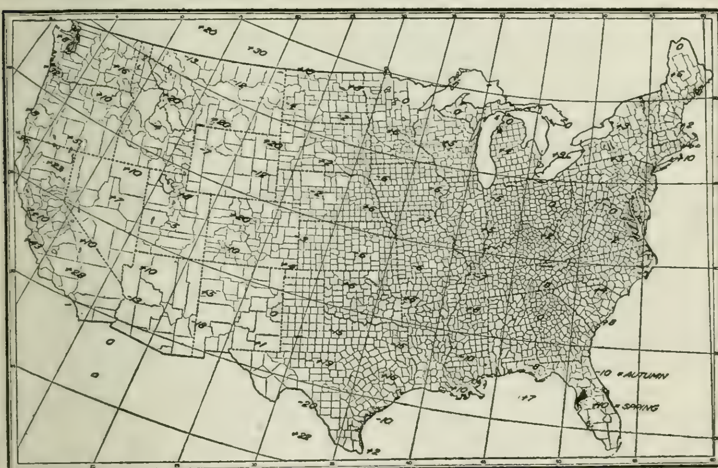

Fig. 2. Isophanal Map of the United States in 5 degree isophanes and 5 x 5 degree quadrangles to illustrate method of designating phenological areas for the study of influences which contribute to time, altitude or latitude departures from the geographical constants. The estimated minus (earlier) and plus (later) departures in days from the computed time constant for spring and autumn events, as given for each quadrangle, are based on a study of more than 40,000 reports on the date wheat harvest begins and on other statistics of planting and harvest dates for wheat, potatoes, etc., and represent averages for the entire quadrangle.

puting calendars and tables which aid very much in the computation of phenological dates.

Dr. Hopkins informs us that the rates of variation in the dates of periodic events were determined earlier by Schubler in 1830 for the distance between Parma, Italy, and Greifswald, Prussia, as 4 days for a difference of about 325 feet of altitude and 1 degree of latitude. Although Quetelet, in 1846, was aware of the influence of longitude, it remained for Fritsch, in 1865, to state that each degree of longitude westward made a variation of 4/10 of a day. In 1893 Ihne found the variation to be about 9/10 of a day. Dr. Hopkins, in 1900, concluded from his investigations in West Virginia that the rate of variation was 4 days to 1 degree of latitude and 400 feet of altitude, and later in 1915 concluded that there was a variation of 4 days to 5 degrees of longitude.

The Bioclimatic Law. The Bioclimatic Law may be stated as follows: *The variation in the time in which periodical events occur in the seasonal development and habits of plants and animals at different geographical positions within the range of their distribution is, other things being equal, at the rate of four days for each degree of latitude, five degrees of longitude, or 400 feet of altitude.*

According to this law, lines running from the east toward the north-west at the rate of one degree of latitude to five degrees of longitude represent the same constant or average date of periodical phenomenon for any given level throughout their length. Such lines are called *isophanal lines,* and in accordance with this law Dr. Hopkins has constructed isophanal maps of the United States (Fig. 1). Meridian lines drawn at right angles to the isophanal lines are called *phenological meridians.*

The influence of certain local factors that modify the average dates of the periodic phenomena for each quadrangle, such as topography, lakes, large rivers, rainfall, sunshine, etc., according to their intensity, is marked on each quadrangle as plus (later) or minus (earlier) departures for both spring and autumn (Fig. 2).

Dr. Hopkins believes that the amount of departure of the actual from the computed date for any locality represents the intensity of the action of local factors.

For example, in Florida the departures are ten days earlier than computed time for autumn and ten days later for spring events; for Western Ontario only nine days later for autumn. Such departures were based on a study of more than 40,000 reports on the date wheat harvest begins.

The departure constants were obtained by establishing *phenological bases* or "localities where a sufficient number of observations have been made to establish corrections for local and regional influences, so that the date of any seasonal event recorded there may serve as a reliable basis for the computation of corresponding dates for the same event at any other geographical position within the same or different regions of a country or continent."

Wooster, Ohio, was taken as the base for fall wheat seeding on account of the thorough work done there by Webster in connection with the determination of Hessian fly-free dates, while Minnesota was taken as the base for spring wheat seeding.

In accordance with the law and with the amount of departures for different localities Dr. Hopkins, in 1917, proposed to the U. S. Department of Agriculture to make wheat seeding map-calendars for all the States for the purpose of increasing the wheat yields for 1918 by the control of the Hessian Fly. On account of the limited time, however, posters with maps and instructions were prepared for only New York, Pennsylvania, Illinois, Indiana, Nebraska, New

Jersey, West Virginia, Oklahoma, Virginia, North Carolina, and Tennessee. (Fig. 3.)

Fig. 3 is a calendar of winter wheat seeding date constants for map (Fig. 1) computed for latitude, longitude and altitude. To illustrate its use let us select the Guelph region. This lies in the quadrangle bounded by the phenological meridians 45 and 50 and the isophanes 47 and 48 and at an altitude of 1,000 feet. By referring to Fig. 3 it will be seen that the date for winter wheat seeding is September 10th for an altitude of 1,000 feet. Next, by referring to Fig. 2 we find

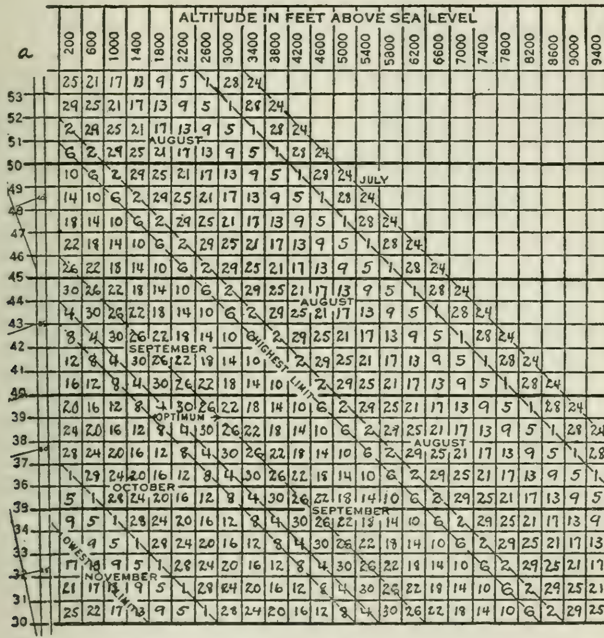

Fig. 3. Calendar of wheat seeding date constants for Isophanal Map, Fig. 1. *a* Isophanes. The dates in this calendar are the computed constants for the given altitudes to be corrected for the 5 x 5 quadrangles of Fig. 2. by adding the + and subtracting the —autumn date which will give the general average date for the average altitude and average season.

the departure constants are 0 for fall events. For this locality, therefore, the best date for winter wheat seeding is September 10th.

It is impossible in the short time allotted me for the presentation of this paper to give in detail the many interesting studies made by Dr. Hopkins in the formulation of his Bioclimatic Law. Such details will be found in *Supplement No. 9 of the Monthly Weather Review*, issued May 1st, 1918, and in an article in the June, 1919, number of the *Scientific Monthly*.

It seems to me that Dr. Hopkins' Bioclimatic Law is an important contribution to service inasmuch as it is based on phenological phenomena which are the best means of determining the influence of all the complex factors that play upon plant and animal life.

I have already referred to the use of the Law in the control of the Hessian Fly. Dr. Hopkins has used it in connection with certain forest insects, viz., the Southern Pine Beetle (*Dendroctonus frontalis*), the Western Pine Beetle (*D. brevicomis*), the Mountain Pine Beetle (*D. monticolae*), and the Pine Bark Louse or Spruce Gall Louse (*Pineus strobi*).

By means of a map-calendar the dates for the beginning and ending of control measures between the autumn and spring flights can be recommended, in the case of the Pine Beetles, and in the case of the Pine Bark Louse the date of hatching and time of moving about.

Dr. Hopkins believes that the Law can be applied with great advantage in farm practice as a means of determining the dates of best seeding and harvesting for the production of maximum crops. While he has shown the application of the Law to winter and spring wheat he is of the opinion that it can be applied equally well to all kinds of crops.

Moreover, it can be used for the making of reliable spray calendars in orchard practice for the control of insect and fungus diseases.

This Law, moreover, is of value in determining the northern limit in the geographical distribution of species of plants and animals. It is, therefore, a valuable supplement to Merriam's work on Life Zones.

Regarding the value of phenology Dr. Hopkins says: "Properly recorded and correctly interpreted there is nothing perhaps to equal the records of the dates of periodical events in plants and animals as indices to the bioclimatic character of a place or local area, because such events are in direct response, not to one or a few, but to all the complex elements and factors of the environment which no artificial instrument or set of instruments yet available will record. In other words, while species and varieties and even individuals of the same species and variety respond in a more or less different degree to the same complex influences, there are certain constant elements in the response of individuals and groups of varieties and species which, if properly interpreted, will serve as a key to the bioclimatic character and conditions which distinguish a particular region, locality, or place from that of other nearby or distant ones.

The Bioclimatic Law in Canada.

Most of the data from which Dr. Hopkins prepared his maps were obtained from the United States, and it will be observed that the departures from the Law constants are practically absent from the Canadian section of his maps. No doubt the reason for this absence was the lack of sufficient data from Canada.

The writer believes, however, that Canada has the data if they can only be compiled. This country has not only a large number of experiment stations scattered from the Atlantic to the Pacific, but also a large number of reports prepared by Federal and Provincial agencies, that could supply the necessary data relating to phenological phenomena. A compilation of such data would be most valuable in extending the practical application of the Bioclimatic Law to the different sections of Canada. The writer expresses the hope that some competent

government official may be detailed to gather such data, so that Canada may reap the advantages which may flow from the application of the Law to agricultural practice and to the solution of many entomological and other problems.

FRIDAY MORNING, 9 O'CLOCK.

LOCUSTS IN MANITOBA, WITH SPECIAL REFERENCE TO THE OUTBREAK OF 1919.

NORMAN CRIDDLE, DOMINION ENTOMOLOGICAL LABORATORY, TREESBANK, MAN.

We have had locust plagues in the Prairie Provinces as far back as history will take us; that they occurred long before that time is extremely probable. There were, however, no crops in those days and very few observers, consequently the locust outbreaks were imperfectly recorded and our knowledge of the species involved is extremely dubious. There were at least seven distinct locust outbreaks in the Nineteenth Century most of which extended over two or more years. The first was recorded from Lord Selkirk Red River colony in 1818, another probably occurred about 1830; then we have records for: 1855-57, 1864-66, 1868-70, 1872-75, 1897-98, and 1900 to 1904 of the new century. In other words there were fully 22 locust years in the last hundred. Another significant point is that in almost every instance the infestation lasted two or more years.

Reading from Riley, and from Lugger of Minnesota, one notes that by far the most important injury in all their records was attributed to the Migratory locust, *Melanoplus spretis,* a species which was supposed to have its permanent abode in the foothills of the Rocky Mountains and from that breeding ground to spread far over the surrounding country. In his later reports Lugger also attributes much to the Lesser Migratory locust, *M. atlanis,* and in a smaller extent to the Pellucid locust, *Camnula pellucida.* Judging from more recent occurrences I think it would be safe in concluding that these latter species were present in most of the former outbreaks, especially the Lesser Migratory locust which is, after all, very like *spretis.*

It is evident from this brief summary of the past, that we can expect locusts to become troublesome at intervals of about 15 years though these periodic visits are not, of course, by any means regular. The insect's appearance depends largely upon meteorological conditions among the most important of which are abnormally dry seasons, especially during May and June. There is one other point to bear in mind and that is while we talk of a locust outbreak every 15 years we should remember that such an invasion does not necessarily cover the whole country because, as a rule, it is far from doing so. Indeed most of our outbreaks have been confined to the southern portion of the province.

My personal experience with locusts dates back to 1900, when we had an outbreak in our neighbourhood involving our own farm among the rest. The species concerned was chiefly *atlanis* though there were a fair number of *spretis* among them for the first two years, after which that species disappeared and has not, so far as I am aware, been heard of since. Much crop was destroyed the first season owing to lack of knowledge and proper equipment. The second year, however, we learned the merits of poisoned baits and from that time forward the comparatively small losses were due almost entirely to neglect.

It is fourteen years since the events I have just recorded took place and during the interval we have been free from locusts in the province. The present year, however, has once more brought the insects into prominence.

The new outbreak is a serious one and promises to become still more so. Fully half a million acres are already involved in the southern portion of Manitoba, while there are several areas of lesser extent isolated from the rest.

Strange as it may seem this severe outbreak came to us as a complete surprise, not a report came in of injury the previous year though we know that the insects must have been present in large numbers. This shows how little one can rely upon farmers for such information and indicates how necessary it is to have reliable scouts to be on the watch for just such a plague. The savings from such observers, on this year alone, would have been sufficient to pay the salaries of half a dozen scouts for the next ten years. When information did reach us the young hoppers were already beyond immediate control, and when I arrived at the infested area whole fields had been swept bare; added to this was the fact that we were totally unprepared and in consequence all the necessary supplies were lacking. It was a week before poison could be shipped into the affected territory, and even then it could not be secured in anything like sufficient quantity to cope with the outbreak. The Winnipeg labor strike was partly to blame for this and it also greatly hampered transportation when the supplies were shipped from the east. These are a few of the first difficulties we had to contend against. Next we had to educate the farmers as to the means of control and this in itself was no simple task. Most of the farmers involved had never witnessed a locust outbreak before and when they saw the millions upon millions of tiny hoppers turning the green fields black, many lost heart. Scoffers, too, were numerous, but some enterprising men remained and by their aid examples were provided which added much to our own demonstrations. Dead hoppers, small and hard to find among the grass, were pointed out and as their numbers increased, and the dark areas grew no larger, farmers took heart again; but only temporarily, soon fresh hordes were making their way over the bodies of their dead companions and commenced to eat new inroads into the crop. It was at this time that the human barometer fell very low indeed and but for the former experience of a few men we might have had difficulty in keeping the work going. Some farmers did indeed lose all hope and, later, their crops also. Others of more persistent character continued in their efforts and ultimately had the satisfaction of at least saving part of their crops. As for the dead locusts it is hard to realize the vast numbers that covered the ground. In one instance we found an average of 244 dead to the foot over a large field, that is to say approximately 260 bushels per acre. On one square foot at another place I counted 641 dead locusts, two-thirds of which were adults. I give these instances from many similar ones. Had these locusts been permitted to breed they would have produced at least 6,000 eggs to every square foot of land on the field and these in their turn would have provided locusts enough to destroy fully two thousand acres of crop next year.

Much of the success obtained was due to the Provincial departments supplying the poison free, while the municipalities, as a rule, provided the bran and attractants. There was some delay, however, before these measures were adopted; many farmers in the meantime, procuring their own materials.

Our measures of control did not differ to any marked extent from those in use elsewhere: we relied chiefly upon the Kansas bait partly because it was more easily mixed and also because it seemed more attractive to the grasshoppers than

the Criddle mixture. Another point in favor of the former was the difficulty in securing horse droppings in sufficient quantity. However, there were some farmers in nearly every district who spoke very highly of the droppings and used nothing else. Two instances came to my notice where the farmers had used manure spreaders and while this might seem a rather extravagant method of spreading poison, we must take into consideration the cheapness of the material which would permit a far greater quantity to be used in comparison with Kansas bait, at the same cost. The results of this method were, at least, all that could be desired and probably exceeded any other.

Later in the season a large type of hopper catcher was used, this being an improved model of the old hopper-dozer. It was sixteen feet long and some three feet in height, made, apart from the frame, with galvanized iron. With this implement, drawn by two horses, some farmers claimed to have caught as many as fourteen bushels of locusts in one day. Certainly some excellent work was done with them while the enthusiasm lasted, but in spite of the apparent success I am of the opinion that the machines are a poor substitute for poison baits.

There is one feature in the present locust outbreak that makes it different from any other we have experienced in western Canada and that is the fact that we have had to deal with an entirely different kind of locust. Our previous knowledge referred entirely to the genus *Melanoplus* and chiefly to the Migratory and Lesser Migratory species, whereas the present insects involved are largely the Pellucid locust. It was, perhaps fortunate that we visited the infested districts before giving advice and more so that we were able to distinguish the species involved, because the habits of the two genera are different in many respects. For instance the species of *Melanoplus* we have been dealing with, oviposit in and around small openings amid sparse vegetation, or more frequently still, in the stubble fields. Camnula, on the other hand, avoids such places and instead, selects the roadsides and sodded areas, depositing its eggs in the clumps of grass. It thus happened that instead of swarming of the stubble fields, as might have been expected before knowing the species, the insects came from the roadsides. This was how conditions were in most districts, but in a few *Melanoplus* predominated, while in others, all kinds were found together.

It is an interesting sight to see the small hoppers all moving in one direction, as if all were induced by a similar impulse. These movements may be towards the sun or away from it, with or against the wind so that it is difficult to arrive at a reason for the uniformity of movement. One thing is certain: having once located a field they seldom abandon it while food remains available. Moving inward they first steadily work their way towards the centre of the field while the rear guard clean up what is left, or that which re-sprouts. Large masses of these hoppers may also be seen in the morning while the dew is still on the herbage, sunning themselves before partaking of the morning meal. It is then that they sometimes gather along roadsides so thickly that the road looks black with them; on other occasions they have been known to collect on the railway irons in such numbers as to actually stop the trains. The greatest sight of all, however, is to see a migration after the insects have attained the winged stage. At such times they move in regular swarms and drift along with the wind like a thick snow storm. Such a swarm may last for hours or but a few minutes. All depends upon the weather, when the sun comes out bright and hot the insects are on the wing in a moment, should a cloud obscure that orb's surface, the locusts as quickly drop to earth again. The flights, too, seem to be infectious because no sooner do the

insects from a distance drift past than those in the vicinity fly up to join them and so add to the moving swarm. To witness such a sight for the first time cannot but prove a joy to the naturalist, but it has a very different effect upon the farmer, who perhaps sees the hard work of months brought to nothing in a few hours. We had instances, at such times, when hundred acre fields of wheat where destroyed in two days by successive swarms of migrating locusts. Other fields, however, were actually freed through the insects moving elsewhere. It was owing to these habits that some farmers who had done little still harvested some crop while other men, working hard to prevent the locusts depredations, lost everything.

The almost daily flights mentioned above, naturally scattered the insects far afield and over much new territory, but while they thus moved in vast numbers their movements were much closer to the ground than are those of the Lesser Migratory locust which often rises far above the area of ordinary vision. *Melanoplus* also takes part in the low flights though less frequently. All species commence to migrate soon after they obtain wings, and continue, on and off, for fully a month and a half. In 1919 they commenced to fly about the middle of July and continued for a considerable time after the insects had begun to oviposit. Indeed there is strong evidence to show that the female frequently deposited one lot of eggs and then moved to other territory to complete her work.

During the wingless stages, and for a time afterwards, the Pellucid locust spreads all through the fields and in this habit resembles the common species of *Melanoplus*, but as the breeding season draws near it returns to the sod land, while the latter remain on the stubble to deposit their eggs. This habit alone usually enables us to distinguish the species involved without seeing it. For instance, should a farmer report extensive cutting of twine we are reasonably safe in referring the injury to species of *Melanoplus* because *Camnula* will be on the sod at the time the grain is cut. The only other insect, therefore, that could be involved would be the larger crickets (*Gryllus assimilis*). Another difference is in the kind of soil preferred, the Lesser Migratory locust inhabits sandy land, *Camnula* the richer soil; though both prefer the dry uplands for egg-laying.

The conditions favoring the increase of any particular species are almost sure to be beneficial to the development of others, consequently there are always others present of lesser importance, and in 1919 we had *Melanoplus minor*, which is the earliest to develop; *M. packardii, gladstoni, dawsoni, bivittatus*, and *femur-rubrum*. The first three are upland species while the last two prefer slightly moister situations. I found a remarkable little outbreak of *M. gladstoni* near Pilot Mound which is, I believe, the first occasion that this species has been recorded as notably injurious.

As I have already mentioned, the eggs of *Camnula* are deposited along roadsides or in pasture fields. Contrary to the general idea the insects, with us, prefer the higher land rather than low spots. Any sodded soil is suitable provided it is comparatively dry. In preparing to oviposit the female selects a low clump of grass in which she forces her abdomen to that the egg mass, that she deposits, is situated among the grasses roots. The eggs, however, are always close to the surface and when the grass clump is a dense one, may actually protrude above ground though, of course, hidden amid the base of the plant. Owing to the peculiarity in selecting egg sites the egg pods, too, are frequently massed together and often actually touching one another in their density. In this connection I have found as many as 84 egg sacks within a square foot, that is to say approximately 2,000 eggs.

It was unfortunate that the seriousness of the 1919 outbreak prevented the few of us engaged in control measures from conducting investigations as to the effectiveness of the various poisons or attractants. When it is considered, however, that the Dominion had but one man in each province and that there was work enough for a dozen, it will be readily understood why we were obliged to devote all our time to the immediate needs of the farmers. In other words, we became, for the time being, demonstrators and encouragers rather than research men. When we view the results, however, we cannot but feel gratified at the thousands of acres that were saved even though much was lost also. We have surely demonstrated what can be done with more effective preparation, and as a result organization is well under way to combat the probable outbreak of next year. We know where the eggs are, having made a careful survey during the autumn months and this knowledge will help us much in locating the young hoppers as soon as they hatch out. We can then attack them immediately rather than wait until they invade the crop.

Deep ploughing has undoubtedly accounted for many eggs, especially in those districts where *Melanoplus* predominated. Unfortunately the sod land is much more difficult to attend to and I fear that it will, in most instances, remain untouched. Experiments conducted at the Treesbank Laboratory, have shown that the eggs, even when incased in their usual covering, cannot withstand a temperature of 90°F. for many hours when the sun is shining and, therefore, exposing them early in the season is an effective means of destroying the eggs. A lesser temperature, however, is not as effective though exposing the eggs to the vicissitudes of autumn, winter and spring may help to prevent their hatching.

Turning to the prospects for next year, we cannot, of course, predict with certainty that there will be an outbreak, as weather conditions may intervene, but judging from the past the chances for this are small, in which case we may expect a worse and more widespread outbreak than the one of 1919. As I said before, I think we shall be prepared. This, however, is a matter that the provinces are chiefly taking in hand. Naturally we have all been working together against the common enemy and for myself, I should like to take this opportunity of expressing my appreciation of the splendid co-operation that has taken place. We have been in the field together and worked together for the common benefit.

LIFE-HISTORY NOTES ON SOME SPECIES OF ACRIDIDAE (*ORTHOPTERA*) FOUND IN BRITISH COLUMBIA.

E. R. Buckell, B.A., Entomological Laboratory, Vernon, B.C.

In presenting some notes on some species of Acrididae occurring in British Columbia I do so with some hesitation for the reason that I have not been able to complete the life-history of many of the species. My hope, however, is that such notes as I have prepared will prove of service to those undertaking any further ecological and life history studies on western species of Acrididae.

My thanks are particularly due to Mr. R. C. Treherne for his encouragement and advice during the past two years in this work, and to Messrs. L. P. Rockwood of the U. S. Federal Entomological Station, Forest Grove, Oregon; and Norman Criddle of the Dominion Entomological Branch, for their kindness in assisting me in the identification of species.

The following species represent the majority of the various Acrididae I have collected in British Columbia during the past two years, and the localities where they were taken.

Acrydiinæ (Tettiginæ)

Acrydium granulatum Kirby. Penticton.
Acrydium ornatum Say. Fairview.

Acridinæ (Tryxalinæ)

Pseudopomala brachyptera (Scudder). Vaseaux Lake. Fairview.
Akentetus unicolor (McNeill). Fairview. Westbank.
Orphulella pelidna (Burm). Fairview.
Chloealtis conspersa Harris. Salmon Arm.
Chloealtis abdominalis Thomas. Salmon Arm. Vernon.
Stirapleura decussata (Scudder). Naramata. Penticton. Fairview. Vaseaux Lake. O. K. Falls. Keremeos.
Ageneotettix scudderi (Burner). Westbank. Fairview.
Aulocara elliotti (Thomas). Westbank. Fairview.
Chorthippus curtipennis (Harris). Penticton. Vernon.

Oedipodinæ

Arphia pseudonietana (Thomas). Salmon Arm. Vernon. Penticton. Fairview.
Camnula pellucida (Scudder). Celesta. Salmon Arm. Vernon. Westbank. Penticton. Fairview. Bridesville.
Hippiscus neglectus (Thomas). Westbank. Penticton. Keremeos. Fairview.
Hippiscus obscurus (Scudder). Westbank. Penticton. Keremeos. Fairview.
Hippiscus vitellinus (Saussure). Penticton. Fairview.
Hippiscus latefasciatus Scudder. Fairview.
Dissosteira carolina (Linnæus). Salmon Arm. Vernon. Penticton. Fairview.
Spharagemon æquale (Say). Vernon. Westbank. Penticton. Fairview.
Mestobregma sp. (probably *kiowa*). Okanagan Landing.
Mestobregma sp. Westbank. Fairview.
Conozoa wallula (Scudder). Vernon. Westbank. Penticton. Fairview.
Circotettix suffusus (Scudder). Celesta. Salmon Arm. Vernon. Westbank. Penticton. Fairview.
Circotettix lobatus Saussure. Fairview.
Trimerotropis cœruleipes (Scudder). Celesta. Salmon Arm. Vernon. Penticton. Fairview.
Trimerotropis vinculata (Scudder). Salmon Arm. Penticton. Fairview.

Locustinæ (Acridiinæ)

Melanoplus atlanis (Riley). Celesta. Salmon Arm. Vernon. Westbank. Penticton. Fairview.
Melanoplus femur-rubrum (DeGeer). Celesta. Salmon Arm. Vernon. Westbank. Penticton. Fairview.
Melanoplus packardii (Scudder). Fairview.
Melanoplus bivittatus (Say). Salmon Arm. Vernon. Penticton. Fairview.
Melanoplus cinereus (Scudder). Fairview.

Acrydiinae.

Two species of the sub-family Acrydiinae were taken during the summer of 1919. Both belong to the Genus *Acrydium.*

Acrydium granulatum Kirby. Large numbers of adults of these insects were taken on April 12th in the meadows at Penticton. During April and May they were common everywhere in damp meadows around Penticton. A few were again taken during the latter part of August. No records of their breeding habits were obtained. The specimens varied greatly in coloration and markings, and all examined were macropterous.

Acrydium ornatum Say. A single male adult of this species was taken on August 7th at Fairview.

Acridinae.

In this sub-family nine species were collected belonging to eight genera.

Pseudopomala brachyptera (Scudder). Two immature insects of this species were taken at Vaseaux Lake, between Penticton and Fairview, on June 14th. No mature specimens were taken this summer.

Akentetus unicolor (McNeill). On June 27th, at Fairview, adults of this species were first seen, and at this date considerable numbers were present on the dry bunch-grass ranges. The nymphs had been observed since the middle of May. By the end of July all were adult and they were found scattered about all over the dry ranges south of Fairview, to the U.S. Boundary Line. A few adults could still be found at the end of August. No observations were obtained as to their breeding habits. These grasshoppers are very active and can jump long distances.

Orphulella pelidna (Burin). These grasshoppers were first taken near Fairview on August 7th (1919) and were found during August fairly commonly near the edges of ponds, and along the banks of the Okanagan River. They were only seen where the grass was still green and were never observed out on the dry ranges. They vary very much in colour, from a dark brown to a bright apple green. They are strong jumpers but do not use their wings much. This is the first time that this insect has been recorded from British Columbia.

Chloealtis abdominalis (Thomas). This species was found in bushy pasture land among dry grass tufts and in burnt-off bush land at Salmon Arm on September 29th. The males were heard stridulating and by approaching them carefully a few were secured.

Only one female was found; it was brachypterous and considerably larger than the males, it was very sluggish and made no attempt to escape but its coloration made it very hard to see among the grass tufts. When the males were at last spotted after a careful stalk they were by no means easy to capture, as they would take one or two big jumps and then burrow down among the leaves and rubbish on the ground, their colour harmonizing closely with their surroundings. When stridulating the males usually crawled up on to a log or stone. These grasshoppers were found again at Vernon on October 4th, on light bush land. The males were stridulating and one or two were secured but I could not find any females. The eggs of this species are laid in rotten logs, fence-posts, etc.

Chloealtis conspersa Harris. One male of this species was taken on September 29th at Salmon Arm while collecting *Chloealtis abdominalis*. These two species are very similar, but *C. conspersa* can be distinguished by having the entire sides of the pronotum and first few segments of the abdomen black, and the lower surface of the last few abdominal segments orange-red.

Stirapleura decussata (Scudder). This species was first observed at Penticton on April 26th on a sheltered stony tract of land from which the snow had gone off early. They were present in considerable numbers but were not very active at this date, not having been out of hibernation very long. A few of them were still in the nymph stage but by far the greater number were adult. As the spring had only opened a short while before and snow was still present on the higher hills, it would have been quite impossible for these to have hatched from eggs this spring and to have grown to adult in this short time. They must, therefore, have hibernated as adults and large nymphs. On May 4th this species was found commonly scattered over the dry range country in the neighborhood of Fairview in the Lower Okanagan Valley. They were most plentiful on stony ground and sage-brush land,

although some were seen on the open bunch-grass plains. They were now fully active and the males could be heard stridulating while at rest upon the ground. When disturbed they would hop away but would not readily take wing. They are silent when in flight. On May 19th this species was found to be egg-laying and from the middle of May to the middle of June oviposition was at its height. From this date on, however, they decreased rapidly in numbers and by the end of June no specimens could be found. I do not know when these eggs hatch, and all that I am able to say about their further life history is that up to September 1st, when my observations ended, no specimens of this species were taken. I think, however, that they would soon have appeared as adults again as another species (*Hippiscus neglectus*) with a similar life history was just appearing again on August 28th.

Ageneotettix scudderi (Bruner). This species was first taken on July 20th at Westbank, and on July 23rd they were found to be fairly common on the dry range land around Fairview. They were very similar in habits and distribution to *Aulocara elliotti* and seemed to take their place, for as *Aulocara elliotti* decreased *Ageneotettix scudderi* increased. Both these species when at their height were the most abundant grasshoppers present on the ranges. Although a small species they were easily seen on the ground on account of their white antennae and bright red hind tibiae. They are an active species with great jumping powers. Toward the end of August they began to decrease and were not so frequently taken, and I think that they had deposited their eggs by this time.

Aulocara elliotti (Thomas). This species at the end of June was the most plentiful grasshopper on the dry range country of the Southern Okanagan Valley. I do not know when this species first appears as adults but I should judge that it would be during the second week in June. By the middle of July adults were very plentiful and were evenly distributed over the range country south of Penticton. It was seen egg-laying in the third week in July from which date it decreased in numbers, its place being taken by a very similar but smaller grasshopper *Ageneotettix scudderi*. *Aulocara elliotti* is a powerful jumper but does not make much use of its wings. A few adults could still be found up to the end of August. The females are very much larger than the males and varied considerably in coloration, some having the white markings on the pronotum very distinct, while in others these markings were hardly visible. The males appeared to be far more numerous than the females and were very active, running on the ground with considerable speed. On several occasions from three to five males were observed following a female. In each case the female was hopping while the males were running rapidly behind.

Chorthippus curtipennis (Harris). Adults of these grasshoppers were collected in considerable numbers on September 1st in a damp meadow at Penticton where the grass was long and green. The males could be heard stridulating. I do not know when this species first appears as adult.

Oedipodinae.

In the Oedipodinae fifteen species were collected belonging to ten genera.

Arphia pseudonietana (Thomas). The first adults of these grasshoppers were seen on July 18th at Penticton. It has practically the same distribution in the Okanagan Valley as *Dissosteira carolina* and appears at about the same date. It is rather more common and more evenly distributed over all types of land than is *D. carolina*, which remains together in small flocks on certain dry hill sides, railroad tracks, etc. The disk of the wing in *A. pseudonietana* is dark red. The

general body colours do not vary much. The usual colour is dark blackish brown with black speckles; the female being larger and lighter in colour. Some specimens are found with a chalky-white pronotum and two or three white bands across the top of the hind femora. This grasshopper flies with a rather slow zigzag flight and can produce, at will, a slow rattling noise when on the wing. Egg-laying is commenced in the last week in August.

Camnula pellucida (Scudder). This species is probably the most destructive grasshopper that we have in British Columbia and has at various times caused very great loss to stockmen and farmers by increasing in enormous numbers and completely destroying crops and range grasses. This year it has been singularly scarce in the Okanagan Valley although it was plentiful in northern Washington State, crossing the British Columbia Boundary Line into the Bridesville-Rockcreek section where it did considerable damage. The first adults were seen at Fairview on June 12th when small swarms were observed in damp places near the Okanagan River where the vegetation was still green. Mating took place during the middle of August and eggs were being laid during the last week in August and doubtless continued until killing frosts occured in the fall.

Hippiscus neglectus (Thomas). The first specimen of this species was found at Penticton on April 4th when the ground was still frozen in many places, and snow was still present in the bush. This specimen was a nymph and was nearly full grown. On April 26th they were found commonly at Penticton and nearly all were adult. On May 4th at Fairview adults were plentiful. These grasshoppers were found in company with *Stirapleura decussata* and *Hippiscus obscurus* and in similar locations, i.e. stony flats and sage-brush lands and a few were seen out on the open bunch-grass plains of the Okanagan Valley. They are not very active and were never observed to stridulate. On May 19th females were seen with their bodies distended with eggs, and they were observed ovipositing in late June. These grasshoppers vary much in coloration and size and are similar to *H. obscurus* differing from this species by the presence of a distinct tegminal stripe. There are two colour varieties, the first having the disk of the wing red and the hind tibiae yellow, and the other the disk of the wing yellow and the hind tibiae red. From my observations this year it appears that the first variety, with red wings, appears first, preceding the yellow-winged variety by several weeks and is also the first to disappear, and this peculiarity seems to be the case with *H. obscurus* also. Adults resulting from the eggs laid in late May and June were beginning to appear during the last week in August and possibly some eggs may be laid in the Fall but the majority of the adults and nymphs seen in the Fall evidently hibernate and reappear in the spring.

Hippiscus obscurus (Scudder). These grasshoppers appear to have exactly the same life history as *Hippiscus neglectus* and only differ from them in the absence of the tegminal stripe. They have the two colour varieties, with the red wings and yellow hind tibiae, which, as before, are the first to appear; and those with yellow wings and red hind tibiae, which are later in appearing. They were found with *Hippiscus neglectus* and *Stirapleura decussata* at Penticton and Fairview in the spring, and freshly emerged specimens were seen again during the last week in August. I believe that this grasshopper is, by some writers, considered to be a variety of *H. neglectus* and not a distinct species.

Hippiscus vitellinus (Saussure). This grasshopper is very similar to *Hippiscus obscurus* but differs from it by having regularly distributed blotches

on the tegmina instead of dark areas tending to form bands. A few were taken at Penticton and Fairview while collecting *H. neglectus* and *H. obscurus*.

Hippiscus latefasciatus (Scudder). Only two adults of this species were seen and both were females. The first was taken on May 4th and the second on May 18th at Fairview. The body of the female taken on May 18th was distended with eggs. Consequently I think that this is another species which hibernates, lays its eggs during May and June, and then reappears in September and October, but further observations are required to determine this. The only other locality where this species has been recorded in British Columbia to my knowledge is from Lillooet, where it was taken by Mr. R. C. Treherne.

Dissosteira carolina (Linnæus). This grasshopper is common along road sides and hard dry places throughout the Okanagan Valley. The first adults were seen at Westbank on July 20th and by the middle of August these grasshoppers were common everywhere. They are very variable in size and colour; some males can be found which measure very little more than an inch in length, while some females measure more than two inches. The general body colour ranges from a pale straw to nearly black passing through various shades of rusty-red and brown. This species is a great lover of dusty roads and may be found in the centre of large towns. By the end of August they were egg-laying. Several were seen in Penticton ovipositing in the earth between the boards of the side-walks. The males of this species have a rather curious " song " during mating time; they jump up into the air until about three feet from the ground and there remain hovering like a hawk in the same spot their wings making a soft rustling sound. After remaining in this position for about half a minute they flutter down to the ground again. There is no dancing up and down and no clicking sounds produced as in the genus *Trimerotropis* or *Circotettix*. This species is found until killed by the frost.

Spharagemon aequale (Say). Adults of this species were seen first at Westbank on July 20th where they were present on the dry range land in considerable numbers. They are active insects often flying long distances before alighting again. When disturbed they fly away in a straight line keeping close to the ground and turning suddenly to one side immediately before alighting, run along the ground for several feet before remaining quiet. This species was frequently seen attacked by a Sarcophagid fly while in flight. During August they were common everywhere on the range lands of the Okanagan Valley and were usually associated with *Trimerotropis vinculata* which they closely resemble. They were seen ovipositing during the latter part of August. A few adults could still be found on the ranges at Vernon on September 15th. The adults of this species were never found together in large numbers but were evenly distributed all over the bunch-grass benches in the valleys and also on some of the higher ranges. There was one very marked variety of this species which was fairly often seen in which the light and dark bands on the tegmina were very clearly defined and the posterior half of the pronotum was white, causing the insect to show up quite conspicuously when resting upon the ground.

Mestobregma (probably *kiowa*). A large number of these grasshoppers were seen on a dry gravelly piece of land adjoining the shore at the north end of the Okanagan Lake, at Okanagan Landing, on September 8th, 1918. I have not taken this species since and they could not be found this year (1919) on the gravelly patch at Okanagan Landing where they were common last year although I searched for them on the same date.

Mestobregma sp. This is an extremely pretty grasshopper when alive; pinned specimens soon lose their colours. Adults of this species were first taken at Fairview on June 27th. During July a few were seen at Westbank and an occasional adult was taken in the neighborhood of Fairview up until the end of August. This species was never found in any numbers, but one or two might be found in a day. They were taken out on the dry bunch-grass flats and were very inactive, often allowing themselves to be caught by hand. No notes were obtained as to their egg-laying habits nor were they ever observed to produce any sound.

Conozoa wallula (Scudder). This was a very common species in certain localities and on certain types of soil. Adults were first observed in large numbers at Westbank on July 20th on a piece of flat sandy ground running out into the Okanagan Lake. This species was seen in many places in the Okanagan Valley, but when observed was always on dry, hot, sandy spots, such as roadsides, waggon tracks across the ranges, on pieces of sandy land in the bend of rivers, or along lake shores. Where they occurred they were usually in large numbers. Although they were all adult by the end of July I noticed no decrease in their numbers at the end of August and I think that they would probably be present until killed by frost. They were very inconspicuous on the ground and very difficult to catch as they were very quick in leaving the ground. When disturbed they only flew a short way before alighting again. The sexes were pairing during the middle of August. This species seemed to be particularly infested by the red mite *Trombidium locustarum,* and I saw some specimens whose under wings were so covered by these mites that they were unable to fly or even to close their tegmina. There were usually some Tachinids and Sarcophagids flying about among these swarms of grasshoppers. The Sarcophagids were observed to dart at the grasshoppers. while they were in flight, as if to place an egg or living larva upon the bodies of the grasshoppers before they closed their wings on alighting. This same thing was noticed in the case of *Spharagemon aequale* and *Trimerotropis vinculata.*

Circotettix suffusus (Scudder). Adults of this species were first collected at Westbank on July 20th where they were commonly seen along the roads. I do not know when this species first appears but I do not think that those collected on this date had been in the adult state long. I did not see many of these grasshoppers this summer in the Southern Okanagan Valley. This is one of the dominant species at Salmon Arm during August and September and may be found commonly in the orchards and along the roads. On September 29th I found large numbers of them in the orchards in company with *Trimerotropis caeruleipes.* They were depositing eggs in the hard ground around the apple trees and nearly all were in good condition. so that in this locality at any rate, they are one of the chief species present during September. This grasshopper is a strong flier and hard to capture. When approached they leave the ground very rapidly, rising to five or six feet in the air and then zigzag away making a very loud and sharp clicking noise.

Circotettix lobatus (Saussure). These grasshoppers were only taken in one or two localities. They were found in considerable numbers on August 7th near Fairview on a rock slide at the foot of a cliff. The males produce a loud crackling and snapping sound when on the wing. They have a regular "song" at mating time; dancing up and down in the air, producing five or six sharp clicks followed by a shrill rattling sound. very similar to the noise made by a rattle-snake. As these grasshoppers seem to occur almost entirely on rocky slopes at the base of cliffs, which is a favorite haunt of the rattle-snake, I have often found that people

mistake their "song" for a rattle-snake which is common in that locality. This species often flies high up on the rocks and rests on the perpendicular face of the cliff and is very hard to capture, its colours harmonizing with the green and grey of the rocks. I do not know where they deposit their eggs.

Trimerotropis caeruleipes (Scudder). This grasshopper does not seem to be at all common in the Okanagan Valley, more especially in the southern half, but is one of the commonest species at Salmon Arm and at more northerly points. It was first taken in the adult form on July 20th at Westbank and a few were collected at Fairview and Penticton during the latter part of August. The only place where this species was seen in any numbers was at Salmon Arm on September 28th. On this date is was seen in large numbers in the orchards and appeared to be at its maximum abundance. They were observed to be pairing and a few were egg-laying. They were found in company with *Trimerotropis vinculata, Circotettix suffusus,* and *Arphia pseudonietana.* The males of this species are much smaller than the females and produce a soft clicking sound when in flight. Frosts of thirteen and ten degrees on September 27th and 28th respectively, caused no visible decrease in the numbers of this species.

Trimerotropis vinculata (Scudder). Adults were first taken at Westbank on July 20th, and from that date on were found in company with *Spharagemon aequale* all over the ranges at Fairview. A few adults were taken at Salmon Arm on September 29th, and had, I think, completed their egg-laying.

Locustinae.

Five species of Locustinae were collected. All belong to the genus *Melanoplus.*

Melanoplus atlanis (Riley). This year there have been remarkably few of any of the genus *Melanoplus* present in British Columbia in the localities where they are usually common. In the southern Okanagan Valley there were very few grasshoppers of this species present. The only place in B.C. to my knowledge, where this species was common was at Celesta on the Shuswap Lake where an outbreak of considerable severity occured. Both this species and *Melanoplus femur-rubrum* have been far more plentiful this year in the humid sections of the Province than they have in the Dry Belt where they are usually most in evidence. They began to hatch about the middle of June, the first of them becoming adult in the latter part of July. Nymphs of this species were still to be found in the beginning of September. Eggs were being deposited during September.

Melanoplus femur-rubrum (DeGeer). These grasshoppers have been fairly numerous this year throughout the Province and I have seen more of this species than I have of *Melanoplus atlanis* which is usually the more abundant species of the two in British Columbia. This grasshopper began hatching about the middle of June and the first adults were taken on July 20th at Westbank. The hatching period of these grasshoppers seems to be very protracted, for nymphs were still found on September 21st in considerable numbers at Vernon. This species was responsible for the outbreak in the Lower Fraser Valley this year. Eggs were being laid during the first week in September and doubtless continued until the frost killed the adults.

Melanoplus packardii (Scudder). This species was only taken on one or two occasions in the Okanagan Valley close to Fairview. It was first seen in a dry gully on June 27th, on which date only a few were adult. On August 22nd this gully was again visited and a considerable number of specimens caught and all were adult. Oviposition began in the third week in August. An odd specimen

was found here and there on the open ranges but it was nowhere very plentiful and not more than fifty specimens were seen during the entire summer. The specimens collected belonged to the form *rufipes* (Cockerell).

Melanoplus bivittatus (Say). This grasshopper was not seen very often this year and did not seem to be nearly as common as usual. The first adult taken was at Fairview on June 27th, but from this date until the middle of August no adults were seen. During the last week in August and in the first week in September a considerable number of females were taken while depositing eggs in the earth betwen the planks of the side-walks at Penticton. At the end of September ragged adults could still be found at Vernon and some eggs were still being deposited.

Melanoplus cinereus (Scudder). Adults of this species were first collected at Fairview on August 7th, and were found during August very occasionally in this locality. They are very pale in colour and have bright blue hind tibiae when alive. Only one male of this species was taken and ten females. They were all taken among sage-brush and *Chrysothamnus* bushes. When disturbed they jumped for great distances and using their wings would usually land in one of these bushes, thus making it very difficult to capture them. Several were found by shaking the *Chrysothamnus* bushes in which they seemed to spend a good deal of their time. They were observed to feed on the leaves of the *Chrysothamnus*. Several large nymphs of this species were seen on August 23rd. This is the first record of this species from Canada.

ONE YEAR'S EXPERIMENTS IN THE CONTROL OF THE CABBAGE MAGGOT.

W. H. Brittain, Provincial Entomologist for Nova Scotia.

Experiments in the control of the cabbage maggot (*Phorbia brassicae* Bouche) were initiated in a small way at Truro in 1917, as a joint project to be carried on co-operatively by the Horticultural and Entomological Departments of the Agricultural College. In 1918 these experiments were continued on a larger scale and the 1919 experiments have grown out of the work of the previous two years, of which they are simply the continuation. Since the records for 1919 reveal nothing inconsistent with the results of the previous seasons, it has been considered sufficient, for the purpose of this paper, to confine our attention entirely to the former. None of the results herein outlined should be considered as final, but we believe that they indicate promising lines for further research, and they form the basis for another season's work. While the utmost care was taken to make the records as accurate as possible and to eliminate possible sources of error, our findings will all be checked up in subsequent seasons before definite recommendations based on our own experiments can be made.

Control Investigations, 1919.

The plots in which the different control experiments were conducted in 1919 were divided into three main series. The first series designated "continuation plots," included trials of those materials found to be of promise in previous years, either in our own experiments or in those of other workers. The second series which were called "field plots," included the three treatments which previous results showed to be most promising, these being applied to later cabbage on a

field scale. The last series known as "trial plots" includes methods or material not previously tested by us.

In addition to these there were a number of small miscellaneous experiments conducted with a view to determining the exact method of action of some of the chief materials used.

I. Continuation Plots.

These plots were situated on a piece of ground 275 ft. long by 30 ft. wide. The plants were set out in rows 2 ft. apart and 18 inches apart in the rows, there being 12 rows each containing 240 cabbages of the Early Jersey Wakefield variety. With the exception of tar paper discs and wire screens, 2 applications of each treatment were made, the first on May 21st, the day the adult flies first made their appearance, and again on May 31st.

The different plots were arranged in triplicate and each section removed as far as possible from the corresponding one, to make more certain of securing a uniform infestation. The table lists the different treatments and gives the results obtained from each. The figures given are representative of costs at Truro during the past season and would doubtless vary materially in different localities and in different seasons. Since, however, they indicate the actual set of conditions encountered by us in growing the crop and treating it for the maggot, they are here given. The figure showing cost of production of an acre of cabbage was worked out and furnished us by Mr. James Dickson of the Horticultural Department of the College.

In the following table showing the results of the different treatments the weight of the heads is taken as the main basis for comparison for several reasons, the most important being that, under our conditions of marketing, sales are made by weight. Consequently, it is simplest to make our calculations on that basis. More important is the fact that this is the only really *quantitative* way to record results. Simply to give the number or percentage destroyed is insufficient, since many cabbages may be dwarfed or retarded, though not actually destroyed or rendered unmarketable. It would be impossible to record the number dwarfed as a result of the work of the maggot or to indicate in any way the degree of dwarfing, since there is no method of determining from the appearance of the plants just where it begins or ends. On the other hand, the total weight from each plot indicates this in a very exact manner. It also brings out the fact that certain treatments increase the weight of heads produced, irrespective of their insecticidal value. The weight, therefore, is the best method of expressing results of the different treatments. The actual price obtained for the cabbage from each plot has been recorded, since this is the point that most interests the commercial grower and is the ultimate test of the practicability of any treatment. The average price per pound is also an important item, for certain treatments retard and others accelerate the developments of the head. Those that hasten the heading up process result in a higher price per pound, as the earliest cabbage brings the highest price.

It will be seen that the tar paper discs from which the earth was removed after the first two cultivations, gave the only absolutely perfect stand outside of the wire screens. In weight of heads, in price per pound and in total net profit per acre, this plot is greatly inferior to the one receiving corrosive sublimate 1—1,000, though this plot lost a single plant. Curiously enough double the strength of corrosive sublimate did not increase the efficiency of the material, but rather appeared to reduce it. Either directly or indirectly the use of this material seemed to bring about a great increase in the weight of heads produced.

TABLE I.—CABBAGE MAGGOT CONTROL EXPERIMENTS—CONTINUATION PLOTS, 1919.

Plot No.	Treatment.	No. Plants destroyed.	Per cent. destroyed.	Weight of Cabbages per plot at harvesting.	Average weight of head.	Calculated No. of lbs. per acre.	Average price per lb.	Price received.	Calculated price per acre.	Cost of Treatment per acre.	Net Profit* per acre.
				lbs. ozs.			c.	$ c.	$ c.	$ c.	$ c.
1	Wire screens	....	....	394 8	1.6	22,989.49	4.38	17 30	1,009 17	265 81	568 96
2	Tar paper discs	55	22.9	409 12	2.2	23,878.18	4.39	18 00	1,050 00	42 00	833 60
3	Scotch soot	75	31.25	326 12	2.0	190,413.56	4.37	14 28	833 00	80 90	577 70
4	Check	183	76.25	139 8	2.4	8,041.95	4.69	6 54	381 50	Check	207 10
5	Tobacco dust, Washing soda, Filler } equal parts	67	27.9	384 8	2.2	22,406.74	4.26	16 37	957 92	48 80	731 72
6	Tobacco dust, Soap powder, Filler } equal parts	53	22.1	378 0	2.0	22,027.95	4.17	15 75	918 75	48 80	695 55
7	Tobacco dust, Scotch soot, Soap powder } equal parts	18	7.5	537 0	2.4	31,293.68	4.22	22 65	1,321 25	63 42	1,083 43
8	Tobacco dust, Sulphur } equal parts	60	25	275 4	1.5	16,040.19	5.58	15 29	891 92	58 44	759 08
9	Corrosive sublimate (1-1,000)	1	0.4	638 12	3.0	37,223.16	4.26	27 17	1,584 92	45 82	1,464 70
10	Corrosive sublimate (2-1,000)	3	1.25	587 4	2.5	34,221.99	4.17	24 48	1,428 00	73 54	1,180 06
11	Tar paper discs. Kept free of soil	....	....	503 8	2.0	29,341.46	4.19	21 01	1,225 58	53 20	997 98
12	Tobacco dust and lime } equal parts	69	28.75	305 8	1.7	17,803.04	3.99	12 19	711 08	39 90	496 78

* Cost of raising plants, setting in field, cultivating, cutting and packing, etc., $174.40.

The foregoing treatments are so greatly superior to any of the others that the latter may be disposed of in a few words. The tobacco dust, soap powder and soot mixture is worthy of note as coming next in efficiency to the foregoing and giving a heavy average weight of head. The tar paper discs from which the soil was not removed, were markedly inferior to those where this was done. The screens, while giving perfect control, are too costly and their application too laborious ever to come into general use, and in addition, they seem to have a bad effect upon the plants. The tobacco dust and lime, while inferior to the foregoing in maggot control gave, nevertheless, greatly superior results to those of last season. This is doubtless due to the fact that the material was put on fresh when the flies first appeared and then renewed ten days later. The previous season the material was applied several days before the appearance of the flies, a heavy rain intervening between that time and their appearance. The tobacco dust is apparently only effective when fresh and its usefulness is destroyed by a heavy rain. In conjunction with sulphur, washing soda or soap powder, is apparently more effective than with lime.

It is interesting to note that practically all the substances used in our continuation plots were mentioned by Slingerland in his bulletin on this insect (Bul. 78, Cornell Univ. Agr. Expt. Sta., 1894), though he did not consider them in all the combinations used by us. Among the effective methods he lists screens and tar paper discs; among the ineffective, soot, sulphur and tobacco dust. The two former he did not test himself, but he did some experiments with the latter, which did not turn out entirely satisfactory. The material was applied twice, the first time immediately after planting, the second ten days later. He does not state whether the flies were out at the time of the first application, but says that they were abundant at the time of the second. As a result of the experiments nearly one-half of the treated plants were salable, while only 90 marketable heads were secured out of 600 of the untreated plants.

Particularly interesting is his mention of corrosive sublimate in view of the success that has lately attended the use of this chemical. On this account we reproduce his remarks in full:

"An editorial in 1864 (*Country Gentleman*, p. 65) states that a contemporary recommends 1 oz. of the substance dissolved in 4 gals. of water. A correspondent of a Canadian Journal (*American Cultivator* for April 30, 1881) says all of the London market gardeners secretly use a solution of 1/4 oz. of this substance in 4 gals. of water for these maggots. He has used the solution quite extensively, using enough to saturate the ground. But it is not clear from the account whether it is applied as a preventive or whether it kills the maggots. We have little faith in its effectiveness but it should be further tested."

The foregoing shows that this material was in use many years ago and it seems strange that it never seems to have made headway until recently. The reason for this may have been that the average person takes no notice of the infestation until the plants begin to wilt, when the maggots are well grown and it is too late to apply control measures. All our experiments indicate that to control the maggot a material must be either a repellent, in which case it should be applied at planting or before the flies appear or, it should be one that will destroy the eggs of very young larvæ, a fact that has often been lost sight of in studies of this pest. If the cabbage can be protected for even two weeks after setting out, our experiments indicate that it stands a very good chance of surviving the attacks of the maggot.

II. Field Plots.

Field tests were conducted on 3,200 cabbages (Danish Round-head). These were the treatments showing most promise in the previous years' experiments. The plants were set out on July 19th during the emergence of the 2nd brood flies and while oviposition was actively proceeding. There was some infestation of the plants in the seed bed, which was mostly, but probably not entirely, removed by carefully washing the roots in water. Two applications at intervals of one week were made in the case of corrosive sublimate. One application of the dust was made and the earth was not removed from the discs after cultivation.

Field Teste on Late Cabbages (3,200 Plants).

Plot No.	Materials used.	No. of Plants.	No. destroyed by maggot.	No. with marketable heads.	Per cent. destroyed by maggot.	Per cent. with marketable heads.
1	Tar paper discs	800	42	758	5.25	94.75
2	Tobacco dust, soap powder and soot (equal parts.)	800	104	696	13.0	87.0
3	Corrosive sublimate (1-1,000.)	800	11	789	1.375	98.625
Check		800	350	450	43.75	56.25

Field Tests on Late Cauliflower (280 Plants).

Plot No.	Materials used.	No. of Plants.	No. destroyed by maggot.	No. with marketable heads.	Per cent. destroyed by maggot.	Per cent. with marketable heads.
1	Tar paper discs	70	5	65	7.14	92.86
2	Tobacco dust and sulphur (equal parts.)	70	15	55	21.42	78.58
3	Corrosive sublimate (1-1,000.)	70	4	66	5.71	94.29
Check		70	16	54	22.86	77.14

The accompanying table shows the treatments given and the results. It will be seen that the corrosive sublimate is again superior to the other treatments, the control being almost perfect. While the other two treatments were hardly given a fair chance in comparison with the corrosive sublimate, the lesser cost of the latter and the prospect of still greater reduction in the price of the material, places it definitely ahead as a method of control of the cabbage maggot.

A similar experiment was carried out on a small adjoining block of cauliflowers, using sulphur in conjunction with the tobacco dust, instead of Scotch soot and soap powder. The results, as will be seen from the table, are comparable.

It was originally intended to make further tests using the main crop of late cabbage, but this was not done as our investigations brought to light the fact that July planted cabbage suffer very little from the attacks of the maggot.

CABBAGE MAGGOT CONTROL EXPERIMENTS—TRIAL PLOTS, 1919.

Plot No.	Treatment.	No. Plants destroyed.	Per cent. destroyed.	Weight of Cabbages per plot at harvesting.	Average weight of head.	Calculated No. of lbs. per acre.	Average price per lb.	Price received.	Calculated price per acre.	Cost of Treatment per acre.	Net Profit per acre.
				lbs. ozs.			c.	$ c.	$ c.	$ c.	$ c.
A	Once transplanted stock	66	33	303 12	2.3	21.262.5	2.65	8 05	563 50	Check	389 10
B	Double dosage nitrate of soda	66	33	383 8	2.8	26,845	2.94	11 31	791 70	..	617 30
C	Planted from seed *	35	17.5	....	....	....	....	....	....	..	....
D	Twice transplanted stock	88	44	344 0	3.0	24,080	4.47	11 96	837 20	..	662 80
1	Creosote, 1% Clay, 99%	2	1	712 0	3.5	49,840	3.73	26 61	1,862 70	26 08	1,662 22
2	Dry lime sulphur, 20% Clay, 80%	93	46.5	232 8	2.2	16,275	2.89	6 74	471 80	49 12	248 28
3	Dry lime sulphur, 20% Tobacco dust, 40% Clay, 40%	21	10.5	409 12	2.3	28,682.5	3.35	13 75	962 50	78 16	711 94
4	Anthracene oil, 1% Clay, 99%	3	1.5	574 0	2.9	40,180	3.57	20 50	1,435 00	27 20	1,223 40
5	Tobacco dust, 40% White arsenic, 5% Clay, 55%	4	2	550 8	2.8	38,535	3.73	20 55	1,438 50	52 62	1,211 48
6	Dry lime sulphur, 20% Arsenate of soda, 7% Clay, 73%	137	68.5	134 12	2.1	9,432.5	3.41	4 60	322 00	77 94	69 66
7	Tobacco dust, 40% Corrosive sublimate, 1% Clay, 59%	1	0.5	643 4	3.2	45,027.5	3.74	24 11	1,687 70	78 16	1,425 14
8	Nicotine sulphate, 2% Clay, 98%	25	12.5	430 8	2.5	30,135	3.05	15 09	1,056 30	53 44	828 46
9	Free nicotine (40% solution), 2% Sulphur, 98%	51	25.5	499 4	3.4	34,947.5	3.76	18 77	1,313 90	53 30	1,129 40
10	Salt solution (50% saturated)	48	24	416 4	2.7	29,137.5	3.41	14 22	995 40	61 30	760 10
11	White arsenic, 5% Clay, 95%	68	34	322 4	2–4	22,557.5	2.92	9 44	660 80	33 58	452 82
12	Para-dichlorobenzene, 10% Clay, 90%	12	6	560 8	3.0	29,235	3.67	20 59	1,441 30	52 56	1,214 90
13	Para-dichlorobenzene, 10% Scotch soot, 90%	6	3	650 12	3–4	45,552.5	3.86	25 16	1,761 20	105 90	1,480 90

Cost of raising plants, setting in field, cultivating, cutting, packing, etc., $174.40.

* Complete records not available from this plot.

Trial Plots, 1919.

For trial of treatments not previously tested in our experiments, we had at our disposal a section of land 170 ft. wide by 60 ft. long. With the rows of cabbage 2 ft. apart, there was thus space for 85 rows of cabbage, and with the plants 18 inches apart in the rows, 40 plants for each row. With seventeen different treatments including checks, this gave us 200 plants (Copenhagen Market) for each plot. Instead of having all the 200 plants for each plot together, however, we divided the piece into five sections, one row i.e., 40 plants in each section being devoted to each of the different treatments. We thus had on this piece of ground five repeatings of each treatment, this method tending to equalize variations in intensity of maggot infestation and any in equalities of the soil that might affect the final weight of heads from each plot.

It will be seen that there are four check plots, each receiving a different horticultural treatment, but none protected from the maggot. All the other treatments with the exception of the salt solution were in the form of dry powder and were applied at the rate of 700 lbs. per acre. In the case of the salt, a saturated solution was first made and this then diluted with an equal quantity of water.

Three of the sections were planted May 31st, the remaining two, June 2nd. An exception to this were the plants on Check Plot D, which were planted a week earlier than the others. It was intended to plant them all on the same date, but conditions arose which made this impossible. Normal applications of nitrate of soda, i.e., 250 lbs. per acre, applied in two equal sowings on June 11th and June 28th were made. On Check B, an extra application was applied on July 12th, this plot receiving a total amount equal to an application of 500 lbs. per acre. All the treated plots received two applications of the material used, the first at planting, the second on June 13th. The first brood flies were actively ovipositing at the time of planting.

Discussion of Results.

Had it been possible to set out these plots two weeks earlier, it would naturally have been a more severe test of the different materials, since they would have been exposed for a longer period during the height of the oviposition period. At the same time the number lost in the check rows enables us to make sufficiently striking comparisons.

A consideration of the results from the check plots shows that "A" and "B" are equal as regards the number of plants killed, but the acceleration of the heading process and the greater weight of head, owing to the extra application of nitrate, have given us a much larger price per acre in the case of "B." Obviously, the results of this treatment would depend upon the chemical requirements of the soil. Plot "C" shows a lower rate of infestation, due doubtless to the fact that it escaped the period of most active oviposition. It also missed the high prices obtained for the early crop. Check Plot "D" having been planted earlier than the others, cannot, unfortunately, be compared with them on an equal basis. Exposed during a longer period of active oviposition, more plants succumbed than in the other check plot. Had conditions been different it is not likely that this would have occurred. As it is, the greater average weight of the heads which survived and the earlier heading up of the plants, gives us the largest financial returns of any of the check plots.

It is obvious that some of the treatments are entirely inadequate to control the maggot. A few show a decided advantage over the check plots, but not sufficient to make them worthy of further trial, in view of the very much better results obtained by other materials. In this class may be mentioned nicotine sulphate and clay, nicotine and sulphur, para-dichlorobenzene alone, and salt solution in the strength tested. Others actually appear to have weakened the plants to such an extent that a greater number succumbed to the attacks of the maggot than on the check rows. These include dry lime sulphur, white arsenic, arsenate of soda and combinations of these compounds. No further discussion is necessary regarding these two classes, all the required facts being found in the table.

A consideration of the other treatments shows that Plot VII, (the tobacco dust, corrosive sublimate and clay mixture) gave the smallest number of plants actually destroyed, but Plot I (creosote) is a close second with only one more casualty and with the largest tonnage per acre of any plot, lower cost of treatment and greater profit per acre. Plot IV (anthracene oil) is only slightly behind the foregoing in number of marketable heads produced, but it also falls below Plot XIII (para-dichlorobenzene and soot) in tonnage per acre. This is probably due to another reason than maggot control as will be seen later. The treatment given to No. V (tobacco dust, white arsenic and clay) is apparently next in efficiency, but this plot also falls below No. XIII in tonnage per acre, and even No. XII (para-dichlorobenzene and clay) which lost three times as many plants, has produced a greater weight of head. No. XIII actually comes second in tonnage per acre produced, though behind the plots previously mentioned in the number of plants free from injury. The plants in this plot were noticeably benefited by the treatment, having a deeper green colour of leaf and a healthier general appearance than the other plots. The results from the foregoing treatments are considered promising and will be tested further in the "Continuation Plots" of 1920. Tested out on earliest planted cabbage, the relative merits of these materials as compared with the test in the "Continuation Plots" of 1919, should be clearly indicated.

THE CONTROL OF THE CABBAGE ROOT MAGGOT IN BRITISH COLUMBIA.

R. C. Treherne, Entomologist in Charge for British Columbia, and M. H. Ruhmann, Assistant Provincial Entomologist.

At the request of Mr. Arthur Gibson, Chief, Division of Field Crop and Garden Insects of the Dominion Entomological Branch, the virtue of the corrosive sublimate treatment for the control of the Cabbage Root Maggot, *Phorbia brassicæ*, was tested in British Columbia during 1919, in comparison with the Tar-paper-disc method of control. At Mr. Gibson's further request the following report is submitted on the record of the experiments performed.

The Plan of Experiment.

The work was conducted altogether in the large commercial vegetable-growing district of Armstrong, B.C., where the Cabbage Root Maggot has for several years exacted a heavy toll. The "block" system of experimentation was adopted in preference to the "row" system. Twelve blocks were employed, with from

70 to 210 plants to a block. Three control untreated blocks were interspaced between the treated blocks and they, with the tar-paper blocks, only received applications of ordinary water on the same occasions as the treatments of corrosive sublimate were made. Six tar-paper-disc blocks, consisting in all of 611 plants were employed in the experiment, interspaced between the other blocks, and three corrosive sublimate blocks on which various strengths were used, at 1 oz. to 6 gallons, 1 oz. to 8 gallons and 1 oz. to 10 gallons of water. The corrosive sublimate blocks were in turn divided into three parts, which received respectively 1, 2 and 3 applications in the season. Observations were made on cabbages and cauliflowers. The following notes deal with cauliflowers in particular and, inasmuch as the cauliflower is more susceptible to injury than the cabbage, it would necessarily follow that what was shown to be the case with the cauliflower would also be so with the cabbage. Cauliflowers were transplanted on May 3rd and set in their permanent positions in the field, and tar-paper discs were placed around the plants at this time. Applications of corrosive sublimate were made on May 7th, May 15th and May 23rd; the first application requiring the use of 1 gallon of diluted mixture, the second application 1½ gallons and the third nearly 2 gallons per 100 plants. One cultivation was given the entire plantation after transplanting between May 3rd and May 23rd.

In checking results a great deal of care was exercised to determine exactly what caused the plants to die or suffer, and observations were made on the vegetative growth and development of the root system. Every plant received a separate number and each was checked weekly throughout the period of the experiment.

Results of Experiment.

The untreated blocks of cauliflowers showed considerable (76.5 per cent.) characteristic injury from maggots and stood out very clearly in the plantation. The tar-paper-disc blocks showed pronounced injury but only 25.3 per cent. of the injury caused was due to maggot attack. Fully 36 per cent. was caused by a "wilt" produced by the presence of the disc. It would be well to mention clearly at this point, that the field chosen for the experiments was a low-lying one with a large quantity of vegetable matter in the soil composition, with a tendency to remain cold for a long time in the spring months. The sun is usually very warm in the Okanagan Valley during May and this last year was no exception in this regard. Consequently with conditions such as these, on cauliflowers, the influence of heat acting on and in association with the subsoil moisture produced a condensation of moisture beneath the disc below the soil surface. This condition was not observed in the case of the cabbages, for the reason that the growth of a cabbage is sufficiently strong to outgrow many adverse conditions. Any check in the growth of cauliflowers is serious in commercial growing, as a process known as "buttoning" takes place. This "wilt" condition was not observed in any case with the plants treated with corrosive sublimate, but some plants were injured by the proximity of fresh manure to the roots, causing the loss "from other causes" shown in the table given below. In fact after three treatments with corrosive sublimate at all three strengths the loss due to maggot attack was less than 2 per cent., and the growth of the plants in "top" and "root" was double the growth on any other block. The results clearly showed that under "bottom" land conditions, with cauliflowers, tar-paper discs were unsatisfactory and that corrosive sublimate in three treatments at 1 oz. to 8 or 10 gallons gave eminently

satisfactory and safe results. With cabbages growing in the same field under same conditions as the cauliflowers the loss due to maggot attack varied in different parts of a two-acre field from 18 per cent. to 50 per cent. Where cabbages had tar-paper discs applied as was the case in one acre, the loss averaged rather less than 5 per cent. from maggot attack. This loss from maggot attack, when tar-paper discs were used in previous years, is considered by growers in the locality a fair average annual loss. Where corrosive sublimate was used on cabbages the loss by maggot attack was less than 5 per cent. and the growth of the plant while somewhat better at the commencement of the year, was not appreciably different at the time of marketing the crop. The summarized results are given herewith:

TABLE I.— Cauliflowers—Averages and Summary.

Form of Treatment.	Percentage. Affected by maggots.	Affected by other causes.
Tar paper discs	25.3	36.4
Corrosive sublimate—		
1 application, 1- 6	68.6	3.9
1- 8	62.0	8.0
1-10	64.0	16.0
2 applications, 1- 6	6.0	4.0
1- 8	62.0	8.0
1-10	64.0	16.0
3 applications, 1- 6	1.8	19.2
1- 8	....	23.4
1-10	1.8	19.0
No control	76.5	21.9

Life-History Notes.

Inasmuch as all previous study given the Cabbage Root Maggot in British Columbia has taken place in the Lower Fraser Valley, this year's work in the Armstrong district adds another locality where this insect has been under observation. The transplanting of the cabbages and cauliflowers was completed by May 3rd in 1919. The first adult flies were captured on May 7th in the field, and on examination of 100 plants on this day, only 3 eggs were taken. Oviposition was heavy previous to May 23rd and on this date small larvae were found in the root systems of some plants that were showing signs of injury. Two large half-grown maggots were seen on this day also. Twenty-five plants were under more or less continuous observation during the early spring and on the dates May 12th and 13th and June 4th, these plants carried respectively 59, 847 and 1,091 eggs, the eggs on each examination being carefully removed by hand. It was exceedingly interesting to note that the largest plants received the greatest number of eggs and in view of the fact that the corrosive sublimate blocks contained the largest plants the blocks were the greatest attraction areas. The same point is drawn on page 27 of Bulletin No. 12 of the Dominion Entomological Branch, 1916, which details, so far as the bulletin relates to British Columbia, the life-history studies carried on in the Lower Fraser Valley. The sundry other points in the life-history of this maggot in the Armstrong district are so closely allied to the results detailed in Bulletin 12 on this insect that there is no need to take up further space in this paper for their discussion.

FURTHER DATA ON THE CONTROL OF THE CABBAGE ROOT MAGGOT IN THE OTTAWA DISTRICT.

ARTHUR GIBSON, CHIEF, DIVISION OF FIELD CROP AND GARDEN INSECTS: ENTOMOLOGICAL BRANCH, DEPARTMENT OF AGRICULTURE, OTTAWA.

Since the publication, in 1912, of our Bulletin on the cabbage root maggot* we have conducted a number of further experiments on the control of this insect, particularly with corrosive sublimate and tobacco dust and lime. The former has received special study during the past four years, and we consider its value to be undoubted and that it has now passed the experimental stage having been used with remarkable success under field conditions. Early references in the literature point to the fact that corrosive sublimate has been known as a remedy for the cabbage root maggot for over 50 years, and it is remarkable that its value has only been appreciated during comparatively recent years. In the years 1916 and 1917 we conducted experiments with corrosive sublimate on a small scale. In 1918, we used in one experiment 800 early cabbage plants. These plants were treated with corrosive sublimate in the strength of one ounce to four gallons of water on four occasions, namely, on May 27th, June 6th, 14th and 23rd. The results from this experiment were very striking, 96 per cent. of the plants treated with the corrosive sublimate being saved. In the same field in which the experiment was conducted the main cabbage plantation was destroyed by the root maggot to the extent of fully 60 per cent. In 1919, over 8,000 cabbage plants were placed at our disposal by Mr. J. I. Farquharson, who resides on the Aylmer Road, near Ottawa. Of this number 2,731 plants of the varieties Jersey Wakefield and Copenhagen Market were used in one experiment. This block of 2,731 cabbage plants was divided into 38 smaller blocks, of which blocks 1 to 18 inclusive, excepting blocks 2, 5, 8, 11, 14, and 17, which were left as checks, were treated with commercial corrosive sublimate mixture in the strengths of 1 oz. in 4 gallons of water, 1 oz. to 6 gallons of water, 1 oz. to 8 gallons of water, and 1 oz. to 10 gallons of water, some blocks having four treatments others only three. The plants were put out in the field on May 12th. The first application was made on the fourth day after planting, the second application six days later and one or two further applications ten days apart, about half a cupful of the mixture being poured around the base of the stem of each plant on each occasion. Each block consisted of 100 plants excepting the checks which varied from 20 to 36 plants each. Blocks 19 to 24 inclusive (100 plants each) excepting checks 20 and 22 (30 plants each) were used for felt-tarred-paper discs of various shapes. Blocks 25 to 23 inclusive (100 plants each) excepting blocks 26, 29, 32, 35, and 38 (20 plants each) were treated with tobacco dust and lime in the proportion of 1 part tobacco dust to 2 parts of lime, 1 part of tobacco dust to 3 parts of lime, and 1 part of tobacco dust to 4 parts of lime, two, three and four applications being made.

The results of this experiment are very striking. Briefly, they are as follows:

CORROSIVE SUBLIMATE. There was practically no difference in the plots treated with the various strengths of corrosive sublimate. The weakest solution, namely, one ounce in ten gallons of water, gave as good results as did the strongest mixture of one ounce to four gallons of water. Three applications, too, are apparently equal to four applications. The percentage of plants destroyed by the maggot

*Bull, 12, Ent. Br., Dept. Agr., 1916.

in all of these plots ranged from 0 per cent. to 4 per cent., whereas the plants in the check plots were destroyed to the extent of 52 per cent.. 57 per cent.. 61 per cent., 66 per cent.. 70 per cent., and 80 per cent. respectively.

Discs Used. Hexagonal disc (block 19); small square disc (block 21); large square disc (block 24): and round disc (block 23). All gave excellent protection. In blocks 19 and 24 (100 plants in each) 100 per cent. results were obtained: in block 21 of similar size 1 per cent. destruction occurred and in the fourth block (23) 2 per cent. destruction. In the two check blocks, Nos. 20 and 22 (30 plants in each) the loss from maggot was 10 per cent. and 17 per cent. respectively.

Tobacco and Lime. One part tobacco dust and 2 of lime, also in proportions 1-3 and 1-4. Block 25, 1 to 2; Block 27, 1 to 3; Block 28, 1 to 4, (100 plants in each) had 4 applications about ½ to 1 inch of the mixture being placed around the stem of each plant. Block 30, 1-2; Block 31, 1-3; Block 33, 1-4 (100 plants in each) had three applications. Block 34, 1-2 (100 plants); Block 36, 1-3; Block 37, 1-4 (150 plants in each) had two applications. The percentage of plants in these blocks destroyed was also very small, varying from 1 per cent. to 4 per cent., the latter percentage being in Blocks 36 and 37 which received two applications only of the more diluted mixtures. Three applications of the mixture was practically as effective as four applications, and the weakest mixture gave practically as good results as the strongest. Check blocks (20 plants in each) with these series, were destroyed as follows: Block 26, 25 per cent.: Block 29, 20 per cent.: Block 32, 30 per cent.; Block 35, 30 per cent.; Block 38, 30 per cent.

A larger plantation of later cabbages, 3,360 in number, planted May 21st, was used for corrosive sublimate solutions solely. The plantation was divided into 11 blocks, 8 of equal size, each consisting of 378 plants, and the remaining three, which were used as check blocks, contained respectively, 105 plants each and one 21 plants. The corrosive sublimate was used in the same strengths as in previous experiment, namely, 1 oz. to 10 gallons water=1:1,280 (Block A, 4 applications: Block B, 3 applications); 1 oz. to 8 gallons water=1:1,024 (Block D, 4 applications: Block E, 3 applications); 1 oz. to 6 gallons water=1:768 (Block G, 4 applications: Block H, 3 applications): 1 oz. to 4 gallons water=1:512 (Block J, 4 applications; Block K, 3 applications). Blocks C, F, I and L were used as checks. Blocks A, D, G and J were treated on May 27th, June 4th, June 13th, and June 24th; Blocks B, E, H and K, on the first three dates only. In this experiment the time required to treat 3,000 plants was 3½ hours, using a watering can with spout closed slightly with wooden plug. In this experiment no attempt was made to keep a definite record of every plant. The blocks were examined at frequent intervals and from a practical standpoint no injury took place in those treated with corrosive sublimate. Conspicuous injury, however, was apparent in the check plots and the plants in these latter were certainly not as thrifty as those treated.

That the cabbage maggot was abundant in the immediate area of our work in 1919 was well evidenced by the losses which took place on the farms close by. Hundreds of plants of the early varieties were completely killed.

The above experiment following those conducted by us previously, particularly in 1917 and 1918, certainly strengthens the belief that in corrosive sublimate we have a valuable control measure for the cabbage maggot.

COST OF TREATMENTS. In connection with the cost of treating cabbages per acre of plants with corrosive sublimate in comparison with cost of applying discs, it is of interest to record the following:

Corrosive sublimate.—Total cost per acre, including labor and material:	
3 treatments	$24.21
4 "	32.28
Tarred discs.—Total cost per acre, including labor and material	16.75

EFFECT OF CORROSIVE SUBLIMATE ON SOIL BACTERIA. In order to determine the numbers of bacteria in the soil in the field where our cabbage maggot control work was conducted, bacteriological soil tests were made by an assistant, Mr. J. A. Flock, working under Mr. H. T. Gussow, of (*a*) soil treated with corrosive sublimate and (*b*) untreated soil. These soil samples were taken on August 18th, when most of the crop had been harvested. Briefly, the data resulting from these experiments clearly indicated that the corrosive sublimate treatment showed no deleterious influence either upon the plants or on the relative number of soil organisms present in the treated versus the untreated soil. Under field conditions the applications of the corrosive sublimate mixtures certainly seemed to have a stimulating effect upon the growth of the plants.

In the control measures conducted in 1919, Mr. J. A. Flock and Mr. W. P. Shorey, rendered valuable help.

CABBAGE MAGGOT CONTROL.

L. CAESAR AND H. C. HUCKETT.

In neither the Guelph nor Burlington districts did cabbages or cauliflowers suffer any damage worth speaking of in 1919 from the Cabbage Maggot (*Chortophila brassicae*). Only 14 plants out of 7,000 in the plot were killed by the maggots and these 14 were not in any one row but widely distributed over the field.

Fortunately we included in our experiments a plot of radishes, and as radishes were much worse attacked than cabbage some interesting and suggestive results were obtained.

We also devoted considerable time to trying to discover how corrosive sublimate controls the insect.

The results of the work along these two lines is given below:

TABLE SHOWING THE EFFECT OF VARIOUS

PLOT 1—COMPOSED

No. of row.	Date of sowing.	Date plants appeared.	Substance used.	Dates and strength of application.	No. of sound plants.
13	May 3	May 12	Check	Check	4
17	,, 6	,, 13	Check	Check	44
18, 19	,, 6	,, 13	Tobacco dust 1 part and soot 2 parts	May 14 and 26	90
20	,, 6	,, 13	Corrosive sublimate	May 7—1 to 640 May 26—1 to 1,000	128
21	,, 6	,, 13	Corrosive sublimate	May 7—1 to 640 May 26—1 to 1,000	115
22	,, 6	,, 13	Tobacco dust	May 14	55
23	,, 6	,, 13	Tobacco dust	May 14 and 26	34
24	,, 6	,, 13	Tobacco dust	May 14 and 26, and June 10	45
25	,, 6	,, 13	Check	Check	42
26	,, 6	,, 13	Soot	May 14 and 26	11
27a	,, 6	,, 13	Salt (dry)	May 26	8
27b	,, 6	,, 13	Salt (solution)	May 26	10
28	,, 6	,, 13	Corrosive sublimate	May 7—1 to 640 May 26—1 to 1,000	75

PLOT 2—MEDIUM

No. of row.	Date of sowing.	Date plants appeared.	Substance used.	Dates and strength of application.	No. of sound plants.
32	May 26	May 30	Check	Check	121
33a	,, 26	,, 30	Corrosive sublimate	May 31—1 to 240	44
33b	,, 26	,, 30	Corrosive sublimate	May 31—1 to 480	49
33c	,, 26	,, 30	Corrosive sublimate	May 31—1 to 720	60
33d	,, 26	,, 30	Corrosive sublimate	May 31—1 to 1,000	58
34	,, 26	,, 30	Soot	May 31	64
35	,, 26	,, 30	Soot	May 31 and June 7	100
37	,, 26	,, 30	Ammonia	May 31, 1 to 16 of water	....

PLOT 3—LATE

No. of row.	Date of sowing.	Date plants appeared.	Substance used.	Dates and strength of application.	No. of sound plants.
4	July 8	July 16	Corrosive sublimate	July 8—1 to 500	96
5	,, 8	,, 16	Corrosive sublimate	July 16—1 to 1,000	78
6	,, 8	,, 16	Corrosive sublimate	July 8—1 to 500 July 26—1 to 1,000	88
7	,, 8	,, 16	Check	Check	48
8	,, 8	,, 16	Corrosive sublimate	July 8—1 to 500	96
9	,, 8	,, 16	Corrosive sublimate	July 16—1 to 1,000	62
10	,, 8	,, 16	Corrosive sublimate	July 8—1 to 500 July 16—1 to 1,000	115
11	,, 8	,, 16	Check	Check	28
12	,, 8	,, 16	Tobacco dust, sulphur and arsenate of lead	July 8	24
13	,, 8	,, 16	"	July 8 and 16	37
14	,, 8	,, 16	Carco	July 16, 23 and 30	33

SUBSTANCES UPON RADISH MAGGOTS.

of Early Radishes.

No. of wormy plants.	Per cent. wormy.	Remarks.	No. of row.
38	90.4	Roots not nearly so good as in corrosive sublimate rows.	13
94	68.1	" " " " " " " "	17
201	69.1	Vigorous foliage, long, rough, slender, poor quality roots.	18, 19
17	11.7	Moderate foliage, large, globular, smooth, good quality roots.	20
18	13.5	" " " " " " " "	21
50	47.6	Vigorous foliage, long, slender, rough, poor quality roots.	22
68	67.9	" " " " " " " "	23
70	60.8	" " " " " " " "	24
79	65.2	Roots not nearly so good as on corrosive sublimate rows.	25
50	81.9	Roots like tobacco rows, much inferior to corrosive sublimate.	26
30	78.9	Not a good test.	27a
25	71.4	" " "	27b
37	33.0	Mostly surface injury; good roots for table purposes.	28

Early Radishes.

No. of wormy plants.	Per cent. wormy.	Remarks.	No. of row.
121	50.0	Not so good roots as on corrosive sublimate rows.	32
0	0.0	Good quality of roots, growth of young plants checked at first	33a
0	0.0	" " " " " " " "	33b
3	4.7	" " " " " " " "	33c
1	0.9	" " " " " " " "	33d
82	56.2	Foliage good, roots not so good as corrosive sublimate rows.	34
128	56.1	" " " " " " " "	35
0	0.0	All plants killed; same result later where 1 part to 32 of water was used.	37

Radishes.

No. of wormy plants.	Per cent. wormy.	Remarks.	No. of row.
20	17.2		4
7	8.2	Note: The later application gave the better results.	5
4	4.3	Note: The two applications gave better results than one.	6
15	23.8		7
27	21.9		8
12	16.2	The later date here again gave better results than row 8.	9
8	6.5	Note: Two applications better than one.	10
12	30.0		11
15	38.4		12
18	32.7		13
9	21.4		14

INFERENCES FROM THE ABOVE TABLE AND FROM OBSERVATIONS IN THE FIELD.

First. Corrosive sublimate was the only substance used which gave satisfactory or fairly satisfactory results, the results from it being better than the percentages indicate, because nearly all the injuries were on the surface, only a few being deep in the tissues, whereas in the checks a considerable percentage were deep in the tissues. The plants were somewhat older than usual when pulled. This possibly accounts for surface injuries.

Second. Tobacco dust alone, or soft coal soot alone, or a combination of the two, or a combination of tobacco dust, sulphur and arsenate of lead powder, gave no control and in most cases seemed to encourage the presence of the insect.

Third. Under conditions such as we had last year, corrosive sublimate had a decidedly beneficial result upon the size, shape and quality of the radishes causing them to be smooth-skinned and of good size. On the contrary, tobacco and soot both acted as fertilizers and gave excellent foliage but inferior form and size of the enlarged part of the root, this being elongate, slender, rough on the surface and unattractive in appearance.

Fourth. Corrosive sublimate if applied stronger than 1-1,000 to young plants, weakens them and causes a distinct shock, though they soon outgrow this. The same thing happens to cabbages if the roots, when being transplanted, are soaked a couple of minutes in the liquid, yet even then they recover. Too heavy soaking of soil around very young plants in the field, even with 1 to 1,000 may cause a sickly appearance of foliage for a few days.

Fifth. Sufficient tests have not been made yet to allow a reliable conclusion to be formed as to the best time to apply corrosive sublimate to radishes.

Sixth. Corrosive sublimate applied within 24 hours of sowing the seed appears to have no injurious effect upon germination.

HOW DOES CORROSIVE SUBLIMATE ACT IN THE CONTROL OF THE CABBAGE MAGGOT?

1. DOES IT KILL THE EGGS? Eggs were placed on blotting paper in pill boxes containing soil freshly saturated with corrosive sublimate 1-1,000. The result was that of 80 eggs treated, 64 or 80 per cent. hatched. In the check, out of 134 eggs, 128 hatched or 95 per cent. The above results represent not a single test, but a series with a few eggs at a time. There seems no doubt therefore, that if the eggs hatch under these circumstances, they would hatch in the field in soil treated with corrosive sublimate.

2. DOES IT KILL THE LARVÆ? Various methods were employed to test whether corrosive sublimate kills the larvæ in any stage of their growth.

Out of 190 larvæ treated 83 pupated, 4 remained larvæ to the end of the test and 103 or 56.8 per cent. were missing. More would have been missing had they not in some cases been put in retainers from which they could not escape.

In the checks, out of 46 larvæ, 35 pupated and 11 or 23.8 per cent. were missing, 5 of these by accident.

Some of the missing treated larvæ were doubtless killed, especially the very small larvæ, but most of them crawled away and escaped. Where the larvæ were confined so that they could not escape, it was found that, while a good many died, yet many lived. It was observed however, that there was an evident desire both of large and small larvæ to avoid contact with this liquid compared with water. *Our inference* is therefore, that control is not to any large extent brought about by the death of the larvæ from contact with corrosive sub-

limate, but possibly from its repellent action, which causes the larvae to wander away from the plant and thus perish. Larvae, however, once well inside the plant, do not seem to be affected.

3. Does it Kill the Pupae? Three flower pots filled with fine sandy soil were sunk in the soil this spring and then thoroughly saturated with corrosive sublimate. Pot 1 contained 100 puparia and was saturated with 1-1,000 strength.

Pot 2 contained 100 puparia and was saturated with 1-1,000 strength.

Pot 3 contained 35 puparia and was saturated with 1-240 strength.

Eight other pots containing in all 885 pupae were left untreated and served as checks.

Results.

Pot 1 of the treated puparia gave an emergence of 11 flies.
Pot 2 of the treated puparia gave an emergence of 47 flies.
Pot 3 of the treated puparia gave an emergence of 2 flies.
Total emergence from treated pots 60=25.5 per cent.

From the 885 pupae in the checks 174 flies, or 19.6 per cent. emerged. We can therefore only conclude that corrosive sublimate does not kill the pupae.

Incidentally it may be mentioned that from the 885 untreated pupae, 124 cynipid and 15 staphylinid parasites emerged, and from the 235 treated puparia 20 cynipids and 1 staphylinid.

THE PRESENT STATUS OF MILL-INFESTING PESTS IN CANADA.

E. H. Strickland, Entomological Branch, Ottawa.

The Entomological Branch of the Dominion Department of Agriculture is undertaking a series of investigations and experiments upon the control of the insect and other pests of flour mills, bakeries, elevators and warehouses. This has necessitated a preliminary visit to representatives of these various industries throughout the Dominion for the purpose of ascertaining what are the most important pests, and the effectiveness of methods already in operation for their control.

In so far as the flour mills are concerned one pest, namely, the Mediterranean Flour Moth (*Ephestia kuehniella*), so far exceeds all other classes of mill pests in the trouble it causes, that the majority of millers look upon it as the only one meriting serious consideration. One of the favorite breeding places of this pest is inside the legs of conveyors, where the larvae spin a voluminous mass of silk, which collects large quantities of flour and dust. If no precautions are taken this, in time, entirely clogs the elevator, which must then be dismantled and thoroughly cleaned.

One other group of mill pests—the Flour Beetles (*Tribolium* spp.) is almost as prolific in Canadian mills as is the moth, but since these beetles do not interfere with the milling process they are, unfortunately, inclined to be tolerated in the various parts of a mill which they inhabit. From the millers' point of view this is readily understood. The moth is a serious menace to the smooth running of the mill. Hence its control is of great, sometimes even of vital, importance to the operation of an infested mill. The beetles on the other hand do not inconvenience the miller, and they are readily sifted out of flour, which apparently

leaves the mill in as good condition as if it had never been in contact with them. Suppose, however, one takes a sample of flour which is, to all appearance, in good condition from the mill badly infested with these beetles, and places it in a tightly closed tin, thus assuring that no beetles can obtain entrance for oviposition. An examination of this tin, say in six months' time, will in all probability reveal the presence of a large number of beetles. This is due to the fact that the beetle lays its eggs in such places as the inside of spouts, and in elevator boots. Thus the presence of the beetles results in the contamination of passing flour with eggs. They measure about 1/60 inch in diameter and could never be detected in the flour.

The owner of a badly infested mill rarely experiences any trouble with his flour, since he stores it for a very short time, and when it leaves his warehouse it is, in so far as he knows, a perfectly clean consignment. Should this flour be sold for local consumption it will probably be sterilized by being baked before the newly hatched larvae have attained a sufficient size to attract the attention of their consumer. If, on the other hand, the flour is exported to some such warm climate as that of the West Indies, the time which must elapse, together with the temperatures at which it will be kept, before it arrives at its destination, offer every opportunity for the completion of at least the greater part of the beetle's life cycle. A further delay in the consumption of this flour may allow the completion of several generations, with the result that the consignment becomes seriously infested. Such conditions may not often occur, but prior to the general adoption of control measures, complaints were more frequently made of infestations developing in consignments of exported flour. Hence, from a national point of view, it is seen that mill pests have a greater significance than merely in so far as they affect the mill in which they live and breed.

Fortunately, we have at our disposal several means of reducing to a minimum, if not in all cases entirely eradicating, these pests, and the majority of millers have shown great energy and enterprise in adapting these remedies to their mills. The most important control measures are: superheating, fumigating and freezing.

Superheating is a method of control based upon the observation that a temperature of about 120° Fah. will destroy any stage of insect life in a very short time. A mill in which the pests are controlled by superheating is usually fitted with sufficient permanent steam pipes to raise its "room temperature" to about 130° F., but similar results can be obtained with the aid of temporary coils, and by utilizing the heat from a drier.

Heating is most conveniently effected over a week-end. When the mill closes down on Saturday night all elevator boots, etc., are opened up to allow a free circulation of air, and the heat is turned on. By the following morning the required temperature is obtained, and by preference it is maintained for over twenty hours. This duration of time is not necessary for the destruction of exposed pests, but it is desirable in order to assure that the heat penetrates into all accessible places. Work can be resumed on the Monday, though the first part of this day is usually occupied in giving the mill a thorough cleaning down. The result of this treatment is that all species of mill pests, in whatever stage they were present, have been destroyed in every part of the mill which was raised to a temperature of 120°, whether such places were accessible to a free circulation of air or not. Superheating is becoming increasingly popular with millers, and it is significant that only those who have never employed it are able to advance serious objections to its use.

Fumigation with hydrocyanic acid gas is a control method which served a very useful purpose before the superheating process was perfected, but it must now be relegated to the "out-of-date" class, since it has the following disadvantages when compared with the rival method: 1. It is dangerous to human life. 2. While the initial expense is less than that of installing an efficient heating system every subsequent operation is far more expensive than that of turning on the steam. 3. The gas fumes are less penetrating than the heat, and since a high concentration is required for the destruction of eggs many of these, which are laid in protected places, may escape. 4. The mill must be idle for a longer period at each operation.

Freezing is a method much in vogue in the Prairie Provinces, where extremely low temperatures can be relied upon at almost any time in the winter. When there is so much of this "natural resource" annually going to waste it would seem to be desirable that it be utilized to the greatest extent possible. We have no records of experimental data as to what low temperature is necessary to destroy the different stages of the various pests, and there is some doubt as to whether the extreme cold experienced in this country will destroy all of the stages. Some of the smaller mills do not run at all in the winter but they never appear to be quite free from pests when they commence operations in the spring. This may, however, be due to an annual re-infestation.

A mill, when it is opened up to freeze for a couple of days, is usually submitted just before or after the operation to a more vigorous cleaning than it receives at any other time in the year. To what extent the evident benefit derived can be ascribed to the cold or to the broom is a debatable point. Adults of the moth and the beetle certainly perish without exception at 25° below zero, but we have no definite data as yet upon the effect on immature stages.

Freezing is, in most cases, acknowledged to be hard on the mill. Steam pipes obviously must be completely drained, and this is not always easy. Some lubricating oils stiffen up at low temperatures, and the mill should not be re-started until it has warmed up to normal temperature. Metal work warms up more slowly than the rest of the mill. This results in sweating, which collects dust and may even cause rust. These difficulties have been overcome in several mills, among them some of the largest in the country, and freezing is practised by them with evident success. The first cold snap of winter is, however, usually rather anxiously awaited in such mills since, by the time it arrives, the moth is often "getting pretty numerous again." This is the main disadvantage to freezing as the sole method of controlling pests. It cannot be applied at any season of the year, and is not available in the summer when the moths are most active. It is, however, to be hoped that an opportunity will be offered this winter for us to obtain some definite data upon the value that low temperatures have in the extermination of mill pests.

These, then, are the chief methods of reducing the pests in our mills, but we are faced with one more problem in this connection, namely, that of re-infestation. This possibly is the main problem, and certainly, had it been solved in the first place, the problems of eradication would have been non-existent, for mill pests are not indigenous to mills. Some of the newest mills in the country have been heavily infested almost as soon as they were put into commission, while some others have remained almost free after many years of running.

Often this infestation, and re-infestation after eradication, is well-nigh unavoidable. A city mill with a local trade stands little chance of immunity.

but a large isolated mill, catering mainly to export trade, should avoid infestation if proper precautions are taken.

In probably 90 per cent. of the mills now infested with moths the pest has been introduced in second-hand bags. These bags are rarely taken into the mill. In most cases they are dumped into the adjacent warehouse to be used for feed stuffs. Sometimes they are cleaned with beaters or by suction, but a few eggs are liable to escape destruction by either treatment. More often the bags are not treated at all. In either case, the warehouse sooner or later becomes infested and it is only a matter of time as to when the pest will appear in the mill itself. The moths are rather unwilling fliers but they are very tame and are readily conveyed from one room to another on the clothes of people passing back and forth.

The remedies which are suggested for this means of infestation are:

(1) To avoid using second hand bags entirely. This, however, is not often practicable, except in the case of manufacturers of special brands of breakfast foods, whose reputation would suffer immeasurably were they to be unfortunate enough to distribute a consignment of "buggy" cereals among an unforgiving public.

(2) To sterilize by heat all second-hand bags before they are allowed to enter the warehouse. The bags should be allowed to accumulate in a small detached building which can be superheated say, once every two weeks; after each operation all of the contained bags should be transferred to the warehouse before more are admitted.

For a new uninfested mill such a method would pay for its small initial cost in a few months. In so far as we are aware, this method is not actually in use as yet in any mill, though it is "under construction" in at least one plant.

(3) To superheat the warehouse as well as the mill. This method would entail too much expense to be practised for most mills, though it would be of great value.

Generally speaking, then, millers throughout the country are keenly alive to the questions relating to the control of pests, but it would seem that a little more attention might be paid to the problem of avoiding re-infestation of a mill once it has been effectively cleared of its present unwelcome guests.

SOME NOTES ON THE LIFE HISTORY OF OUR COMMON JUNE BEETLES.

H. F. Hudson, Dominion Entomological Laboratory, Strathroy.

The white grub, the immature form of the May or June beetle, is one of the most important and most injurious of soil-infesting insects, and one of the hardest to control, on the sand and sandy loam soils of Western Ontario. They may occur occasionally in clay soils, but I have never observed or known of any injury by these insects on the heavier types of soil. Since 1914, observations on the life history of these important insects have been under observation, and though the work has had a chequered career, we have been able to breed out from the egg, the complete life history of three species. So far as our collection of beetles is concerned, and that involves many thousands, we have in Middlesex County seven distinct species, but probably only four are really common, although no extensive collections of beetles have been made outside of Caradoc Township. This is somewhat to be regretted as it does not give us a proper idea of the distribution of the different species. The seven species known to exist in Middlesex County are *L. fusca, L. rugosa, L. dubia, L. gibbosa, L. marginalis, L. ilicis,* and *L. inversa.* The three species raised from the egg are *L. dubia, L. rugosa, L. gibbosa.* The year 1914 was an excellent year for the collection of beetles, thousands were present, and ash, willow and butternut trees, were freely stripped of their foliage, while the early blossoms of cherry trees were freely fed on by the beetles. Coming early in May, the time of appearance being governed largely by temperature the beetles soon pair, frequently before they have eaten anything, but from observation eggs are not laid until from two to three weeks after fertilization. The female pairs frequently, at least I have seen the same pairs frequently in copula in their breeding cages. Pairs taken in copula May 16th, 1914, did not lay eggs until June 16th, but this was possibly due to my negligence in omitting to place a piece of sod in the breeding cage for the female to oviposit in. I noticed the day after the sod was introduced eggs were laid. The eggs are small, oval, of a pearly white lustre, each deposited singly in a ball of earth from 2 in. to 6 in. below the surface. After having been laid several days the eggs increase slightly in size, probably due to the absorption of moisture, become spherical in form and change to a reddish colour just prior to hatching. Our breeding cage records show that eggs hatch in from ten days to three weeks with an average of two weeks. This is somewhat difficult to gauge as we have noticed breaking open the little balls of earth to ascertain the egg yield, has undoubtedly a detrimental effect on the vitality of the young grub. The work of 1914 was practically concluded owing to the war, and although an assistant was procured in 1915, the results of the previous year's work amounted to nil. With the appointment of Mr. H. G. Crawford in the spring of 1916 the work obtained a new lease of life and much of the success of this work is due to his untiring and unceasing efforts. Starting with two species the results of that work were carried through to completion in the fall of 1918. On my return in the spring of 1917 the work was enlarged and additional species studied. We have now definitely ascertained the life history of *L. gibbosa, L. rugosa,* and *L. dubia* to be at least three years and in some cases it may be four.

The grubs feed most ravenously during the second and third year of their growth, prepare to pupate the latter part of July or early August of the third year

and produce the adult early in September where it lies comfortably in its earthen cell 6 to 8 in. below the surface until the advent of warm spring weather. In 1914 some 8,370 beetles were collected from various trees and shrubs, and a summary of the collection data thus obtained is worthy of mention. *L. gibbosa* is about the earliest species to appear in numbers and is very abundant until the middle of June when its numbers begin to decrease although scattering individuals may be taken until the middle of July. In fact the species comprise 66 per cent. of all beetles collected that year. In point of numbers the males exceed the females in the proportion of 1.71 to 1 or nearly twice as many males as females, the collection from lights and trap lanterns have not been included.

L. rugosa. This species appears about a week later than *gibbosa* and is not an abundant species, it feeds freely on the foliage of most trees. In point of numbers the males exceed the females in the proportion of 1.78 to 1.

L. fusca. Appears about the same time as *gibbosa* but is not so abundant in the early part of the season. Taking the season through it is next to *gibbosa* in order of abundance. The proportion of males to females in this case is reversed, the females predominating in the proportion of 1.47 to 1.

L. dubia. One of the first species to appear in spring but not common. Its season would seem to be shorter than any other species, no specimens having been taken after the 24th June. Females were more abundant than males the former predominating in the ratio of 2.2 to 1.

Notes on Collecting. There are some points of interest in collecting that are worthy of mention. In May and early June the beetle movement is quite regular, and the evening migration takes place usually a few minutes before 8 p.m., and is usually complete in 15 or 20 minutes. They are most abundant on warm nights with a temperature between 65 and 70 degrees, and the best time for collection is between 11.30 p.m. and 1.30 a.m. Likewise the return migration to the ground is similar, and is usually complete by 4 a.m. It seems to be governed by the brightness of the morning and as "West" (8th report Ill. State Ent.) has pointed out, it seems as though the first bird note were a signal for the beetles to fly to their day-time hiding places. Should the temperature be not over 60 degrees, collecting may be safely begun by 9 p.m. as the beetles are not over active at that temperature, but should it be above that it is better to wait a little, until the beetles are less active as they are strongly attracted to lights, and will fly to the light or assemble on the collecting sheets from all directions and from all varieties of trees. The earlier in the evening collections are made the more beating the branches require, while if it is delayed, say until midnight or a little later, the least touch will cause the beetles to fall. It seems as though the cool night air has a stupefying effect, and once dislodged they make no effort to rise again. Collecting from trees inhabited by June beetles does not always indicate that they feed upon that particular plant, as I have ascertained. For instance, on May 18th a soft maple tree was found to be alive with June beetles, and the noise was like the hum of swarms of bees, yet on examination the following morning, no injury of any consequence was observed, except that an occasional outside margin of a leaf had been slightly eaten. Their sole object in thus assembling in this tree was principally for copulation purposes. Their habits in the daytime are equally interesting, leaving their food plants early in the morning, they hide themselves in tufts of grass, or in the soil ½ to 1 in. deep. A heavy rain will keep them in their daytime hiding places, but a light rain will not interfere with their movements. Should a heavy rain come on while they are feeding it has the effect of

making them less attractive to lights. Temperature is a very important factor, the lowest temperature I have recorded when collections were made was 47 degrees at 9 p.m. At this temperature beetles are very scarce.

CONTROL MEASURES. We have been rather unfortunate in securing much information on the natural control of these insects. It is a matter of common observation that crows, blackbirds and domestic poultry feed readily on the young grubs, while skunks undoubtedly also relish them. On several occasions we have reared the tachinid *Microphthalma disjuncta* and probably *Pelecinus polyturator,* although the specimen is not perfect. On two occasions in badly infested fields I collected a number of cocoons of a digger wasp, presumably *Tiphia inornata,* but have not been very fortunate in rearing them out. With the scarcity of birds and other natural agencies of control, the question of suppressing an outbreak seems to be one of agricultural rather than entomological procedure. From a careful survey of the crop rotation on several farms in Caradoc Township, it would seem to indicate that arable land should not be in pasture more than two years and a definite system of short crop rotation followed. The following rotation followed on one farm is of particular importance, in that not only is the fertility of the soil increased, but since the adoption, there has been no injury whatever by white grubs or any other insect. First year oats, seeded to clover, hay crop removed, land planted to wheat, seeded to clover again and planted again to potatoes and corn. Here we have two clover crops in four years and no crop longer than one year on the ground. This, of course, is only applicable to arable land, the question of old pastures is still a perplexed problem, except when brought under cultivaton. Trapping the beetles by the use of lanterns is hardly applicable, because fully 75 per cent. of such collections are males. It would appear that short crop rotations, frequent growing of clover, and clean farming will do more to decrease the spread of this insect than any other means.

REPORT OF THE INSECTS OF THE YEAR—DIVISION NO. 6.

H. F. HUDSON, STRATHROY.

Weather conditions in Western Ontario have been both favorable and otherwise to insect life. The spring was cold and very wet, this was followed by a hot and very dry summer. A brief summary of the more important injurious insects is appended below:

CLOVER LEAF WEEVIL (*P. punctatus*). In the low-lying pasture fields south of London, Ont., more especially in and around Delaware Township, clover and timothy fields were most heavily infested with this weevil. They were present literally by millions and probably no such heavy infestation has ever been witnessed in this section before. Every blade of timothy had a grub curled around it and every clover leaf was badly riddled with small holes and over seventy grubs were taken from a single clover plant. Fortunately the extremely wet weather produced a fungus disease amongst them and in less than a week the whole outbreak had subsided.

CUTWORMS. These insects have been responsible for considerable injury and in nearly all cases the culprit has been the "glassy cutworm." In nearly all cases the affected field was an old sod.

Potato Flea Beetle (*Epitrix cucumeris*). Extremely abundant this year but is readily controlled by spraying with arsenate of lead.

Potato Beetles (*Leptinotarsa decemlineata*). Probably more abundant this year than usual, but late planted potatoes were scarcely injured; in quite a number of cases potatoes planted in late June were not sprayed at all.

Potato Leaf-hopper (*Empasca mali*). An old pest in a new guise. The potato crop in Western Ontario has been considerably reduced in yield, in some cases I should say at least 25 per cent., due to the ravages of this insect. Classed as a new pest by potato growers adequate means of control were not generally known; consequently the insect had almost its own way. I have had partial success by the use of " Black Leaf 40 " and soap, using one tablespoonful of the nicotine solution to one gallon of water plus two ozs. soap.

THE STRAWBERRY ROOT WEEVIL IN BRITISH COLUMBIA.

W. Downes, Victoria, B.C.

Of the many many insects that trouble the small fruit grower perhaps few equal in destructiveness the Strawberry Root Weevil (*Otiorhynchus ovatus* Linn.). Within the last ten years or so its prevalence in the strawberry-growing sections of the British Columbia mainland and Vancouver Island has been a matter of increasing concern to the planters, and in some of the districts where the industry has been longest established it became a question whether its profitable continuance could be any longer maintained.

In Oregon in 1912 some work was done in the study of the Weevil by Prof. A. L. Lovett[1] and notable work was done in British Columbia in 1913 by Mr. R. C. Treherne[2] who established the main principles for its control. During the last two seasons further studies on this insect have been made by the writer in the Gordon Head district of Vancouver Island and some new information regarding its life-history has been brought to light.

The strawberry-growing sections of Vancouver Island are mainly areas of light sandy soil on which the berries seem to do better than on heavier land, though here and there one finds plantations on stronger soil, usually on the lower levels. Cultivation is on the hill system. The worst infestations were found always on the light land, the reason probably being that such soils provide the best facilities for penetration by the young grubs. The degree of infestation usually varied according to the age of the plantations, one-year-old fields being frequently free or showing an average infestation of one or two weevils to the hill. Two-year-old fields would average three or four times that number, while the highest numbers were nearly always recorded from three-year-old fields. This is, however, not by any means a general rule, as much depends on the proximity of young fields to older plantations and cases were found where one-year-old fields adjacent to an old plantation were badly infested, and in 1918 a two-year-old field of five acres was totally destroyed. This field in 1917 produced 2,000 crates of berries; in 1918 only forty were gathered. In this case the owner had been growing strawberries on his farm for many years until a heavy population of weevils had concentrated there; moreover, the situation was aggravated by the practice of planting strawberries after clover sod, a proceeding calculated to provide the succeeding berry crop with a plentiful supply of weevils, as clover is one of the crops upon which the strawberry root weevil thrives.

At the present time, owing to general appreciation of the principles of control, the strawberry root weevil seems to be decreasing in the Gordon Head district. At Keatings, on the Saanich peninsula, a slight increase is reported, and on the Lower Mainland the situation is very much as it was some years ago with heavy infestations reported from certain points.

Origin and Life History.

Recent investigations show that the strawberry root weevil is undoubtedly indigenous and not introduced. Mr. R. C. Treherne[3] has found the weevil at various altitudes up to 4,000 ft. in the mountains and on isolated rocky islands several hundred yards from the mainland. I myself have found it in spots far removed from cultivated areas, and all the evidence tends to show that it is not an introduced insect but primarily a species infesting grasses and various forms of native vegetation. To the list of wild host plants of the larvæ given by Lovett[1] I am able to add two more, Snowberry (*Symphoricarpus racemosus*) and Oak on both of which I have found the larvæ in Victoria. It is a common pest in gardens and the grubs may be found attacking a great variety of plants.

To the list of cultivated plants attacked by the larvæ Red Clover must be added. I have found them very numerous in clover sod at Gordon Head, even in the spring, on sod that had been ploughed down the previous fall. Thus in any scheme of cultivation in which strawberries have a place it would be obviously unwise to plant them following a crop of clover. A suitable system of rotation will be referred to later.

Oviposition. Observations taken during two seasons at Gordon Head showed that the oviposition period extended from the middle of May to the middle of September. The eggs are laid promiscuously around the plants, sometimes against the crown itself, and often buried a quarter to half an inch below the surface. When a crevice in the soil is available this may be taken advantage of as a spot in which to deposit the eggs. Formerly it was supposed that all the eggs were deposited by those weevils which emerged in the summer, but I have this year conclusive evidence that the over-wintered adults also deposit eggs in large numbers. Commencing on April 1st, collections of over-wintered weevils were made at intervals up to June 13th and kept for observation. That these were true over-wintered individuals there can be no doubt, as the earliest date of the emergence of the summer brood at Gordon Head is during the last week in May, and this year adults were not found in the soil in teneral condition until June 13th. Throwing out of consideration those collected in June, we have four lots of over-wintered adults collected on April 1st, May 1st, May 19th and May 31st. The first lot collected commenced to oviposit on May 18th (probably later than under natural conditions) and those collected on May 19th commenced to oviposit on May 28th. All the lots continued to lay eggs throughout the summer until August 30th when oviposition ceased. The highest average number of eggs per individual was 198, laid by those collected on June 13th, and the next highest 130, laid by those collected on May 19th. The earliest lots collected laid very few eggs, averaging 12 and 28 respectively, this being perhaps due to artificial conditions. In the third week in August the weevils began to die rapidly and by the first week in September nearly all were dead.

Oviposition by Summer Brood. It was intended to make the study of this point more complete this year, but owing to an unfortunate accident to our

emergence boxes in the field, sufficient material was not obtained and the data were got from a limited number which were bred in the laboratory. These commenced to deposit eggs on July 20th, probably very much later than would be the case in the field. Under laboratory conditions the weevils are somewhat retarded and do not prove as healthy as those in the field. The vials were examined and the eggs counted every four days. The maximum number of eggs laid by an individual in this experiment was 249 and the minimum 73, while the average was 154, all deposited within a period of six weeks. Thus it will be seen that there are two broods depositing eggs simultaneously. In the case of both broods oviposition ceased at the same time this year but in last year's experiments many weevils continued to lay until the middle of September. Endeavour will be made another season to determine whether the same weevils oviposit twice. In no single instance as yet have I discovered weevils of the summer brood that did not lay eggs and therefore I assume that a proportion of the summer brood does not die but after ovipositing hibernates, and in the spring, after a period spent in feeding and development, oviposits again. If this is not the case, it is difficult to account for the origin of the numerous overwintered individuals.

PARTHENOGENESIS. In all the experiments conducted here no male weevils have been discovered. Although about 200 specimens have been examined and dissected only those have been found possessing the genitalia proper to the female. Also among the large number kept in confinement none were ever found in copulation; neither has it been observed in the field. Consequently the belief has been held by us for some time that *O. ovatus* is parthenogenetic. This impression was strengthened by the recent discovery in France by J. Feytaud[1] that *O. sulcatus*, its near ally, was parthenogenetic, making the fourth Coleopteron known in which the method of reproduction is by parthenogenesis. To test the matter a number of pupae were collected in the field this season and isolated in vials. On reaching adult condition they were placed each in a glass vial loosely stoppered with cotton wrapped round with paper, and fed on strawberry leaves. The vials were kept in my house and examined at intervals of two or three days. At first cotton wool was used for vial stoppers but it was found that the weevils deposited eggs among the wool, making them very difficult to find. When the wool was wrapped in paper the difficulty was surmounted, although the beetles would occasionally deposit eggs in a fold of the paper. Oviposition commenced on July 20th and continued until August 30th. The eggs of each individual were kept separate. On August 24th larvæ were found to have hatched from eggs laid by weevil No. 5 and within a few days larvæ were also found in the other vials. Thus it appears evident that the weevil is parthenogenetic. *O. ovatus* thus makes the fifth coleopteron known to be parthenogenetic the others being *O. turca* Bohem, *O. cribricollis* Gyll, *A. ligustici* Linn., and *O. sulcatus* Fabr. Some individuals produced a larger proportion of infertile eggs than others, and it may be noted that twenty days elapsed between the time when the first food was given and the commencement of oviposition. This is a greater period than would occur in nature and in the experiments conducted by Treherne[2] the minimum period was found to be eight days. I attribute the difference to confinement and artificial conditions of feeding.

INCUBATION AND FERTILITY. Experiments made to find the period of incubation showed that it varied from sixteen to twenty-two days.

The fertility of the eggs varied from 68 per cent. in the case of those laid by overwintered adults to 80 per cent. in the case of those laid by the summer brood.

Duration of Pupal Stage. This was found to vary from ten to twenty-six days. The adults commenced to harden at the end of twelve hours and are completely chitinized in seven days. One individual came to the surface in four days, but while able to climb was not completely hardened.

Emergence of the adults commenced at the end of May. In 1918 the first were taken in the cages on May 25th and the emergence continued until the end of June with a maximum during the second week in June. In 1919 the emergence was later, the first adults being found in teneral condition on June 13th and these would not normally emerge for another week. The season was colder than the previous one and this would account for the difference as the pupae are retarded by lower temperatures.

Migration. On the advent of warm weather in the spring there is a general movement of hibernated weevils from their winter quarters to their feeding ground. Every conceivable spot may be used by them in which to hibernate and where they are especially numerous, dwellings are frequently invaded by them to the consternation and annoyance of the owners. Piles of stones or logs, and fence lines overgrown with weeds and brush form ideal quarters, but where the winters are mild, as on Vancouver Island, many spend the winter among the crowns of the strawberry plants. The weevils begin to move in March and are fairly active until May when their migratory activities appear to lessen, after which, in June, their numbers are augmented by the newly emerging summer brood and a further movement begins which reaches its climax at midsummer, then lessening until late summer when they seek winter quarters.

Regarding the distance travelled by them in a season no definite evidence was obtained, but one new field at Gordon Head, eighty yards wide, was infested throughout in a single season, the weevils coming from an old patch adjoining. The young patch was bordered on three sides by bush so the weevils could only come from the side adjoining the old patch. On this side the average number of larvæ per hill was 27, in the centre 16, and at the further end 7. I would say, therefore, that the weevils would be likely to travel at least double the width of this patch, or from 160 to 200 yards.

Measures of Control. The observations made during the last two seasons have shown that the main principles of control as formerly laid down are undoubtedly correct. There is no poison or chemical treatment of any kind that we know of that can be applied to the plants without injury and will at the same time control the weevil. The question is a cultural one and the best results are obtained by a suitable rotation of crops, a double object being attained by discouraging the weevil and maintaining soil fertility. At Gordon Head the Provincial Government has leased six acres in a badly infested locality and is endeavouring to demonstrate a system suitable to the district. Briefly outlined this would be as follows: Presuming that we start with an infested field, the plants should be pulled up and burnt at the end of August or beginning of September. Leaving them until this time induces the adult weevils to remain in the field and deposit their eggs there. Then the field may be ploughed and should be kept fallow about a month, the spring-tooth cultivator being frequently used to bring out all strawberry roots that may remain. This proceeding will starve out all the young grubs in the soil. A suitable crop to sow the land to would be fall wheat with vetches or clover. The land may remain in clover two years and should then be fall ploughed and potatoes planted the following year. The next year the field may be planted back

to strawberries the land being clean and free from weevils as the potato is one of the crops on which they cannot live.

It is recommended that not more than two crops of strawberries be taken from a field under ordinary conditions. It is not only important not to overcrop the land, but leaving the land in strawberries too long allows the weevils to concentrate there and is inviting disaster. It is also important that judicious applications of barnyard manure be applied to keep the land in good heart. By growing vigorous healthy plants they will be in better condition to stand an attack of weevil and will recover more rapidly. As to the advisability of including clover in the scheme of rotation, we have doubts as to the wisdom of this owing to the danger of maintaining weevil in the land, but we know of nothing that will quite take its place unless it can be shown that it is equally profitable to grow peas or vetches or some other legume and still maintain the fertility of the soil.

The recent light thrown on the oviposition of the weevil emphasizes the necessity of destroying as many adults as possible. It is believed that chickens will prove of the greatest help in this matter and it is suggested that small lots in colony houses should be allowed to run in the plantations. They readily pick up the weevils and the good they do far outbalances the harm done by scratching among the plants. At blossoming time they may be shut up and allowed to run again after the crop is off. The difficulty in closely settled districts of preventing newly set plantations from being re-infested by adjacent old ones is a problem that we are attempting to solve by the aid of wooden barriers with a band of tanglefoot. These have been tried elsewhere and have been found to be partially successful and the results obtained at Gordon Head fully justified us in continuing our experiments. At the present time we have not gone sufficiently far to be able to say that they are commercially practicable but we believe they will prove a useful adjunct in weevil control.

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THE STRAWBERRY WEEVIL.

W. A. Ross and C. H. Curran, Dominion Entomological Laboratory, Vineland Station.

The following paper is based largely on field observations made in 1918-19 and on preliminary experiments conducted during the past season in the Niagara and Oakville districts.

History and Distribution in Canada.

The strawberry weevil is a native insect, which, it is believed, bred originally in the buds of the redbud, the wild blackberry and wild strawberry.*

It has been known as a strawberry pest in Canada at least since 1886. In the Dominion Entomologist's Report for 1890, Mr. W. H. Hale, of Sherbrooke,

* Slingerland and Crosby, Man. of Fruit Insects, p. 373.

makes the following statement: "For several years I have been suffering from the ravages of some sort of insect which attacks the buds of all the staminate varieties of strawberries: a small puncture is made through an unopened sepal and an egg is deposited. The stalk is then partially or entirely cut through. . . . In a large field of strawberries in which 80 per cent. of the rows were pistillate varieties not a single bud was touched, while the remaining rows of strawberries were almost entirely denuded of buds. This same trouble was noticed in Staten Island and Hamilton, Ontario, in 1886. . . ."

Further reference is made to strawberry weevil outbreaks in succeeding reports of the Dominion Entomologist, and also in the reports of the Entomological Society of Ontario.

So far as we are aware the weevil is recorded as being injurious in only two provinces in Canada, viz: Ontario and Quebec.

Host Plants and Injury. In Ontario the strawberry weevil has been bred from the buds of the strawberry, raspberry and blackberry, and it has also been observed attacking wild strawberries and rambler roses. The dewberry, the red-bud or Judas tree and the yellow flowered cinquefoil, are recorded by Slingerland and Crosby as being additional host plants of this species.

The injury is caused by the female weevil cutting off the flower buds, after depositing her eggs within them.

Strawberry. Occasionally the yield of strawberry plantations in Southern Ontario, especially in the Niagara District and Halton County, is seriously reduced by the weevil, or as it is commonly called, "the cutter." For example, in 1918 from 30 to 75 per cent. of the buds in some strawberry fields near Oakville and Jordan were destroyed by the pest. In a badly infested 3/4 acre plantation at Jordan only nineteen crates, or 513 quarts of berries were harvested.

All the common staminate varieties are subject to attack. Varieties with imperfect or pistillate flowers are practically immune.

Raspberry. According to our observations the raspberry crop is never injured to any appreciable extent, chiefly, we believe, because at the time raspberry buds are put forth the overwintering adult weevils are fast dying out. This past season we examined several raspberry plantations adjoining strawberry fields, but even the worst attacked bushes had less than ten per cent. of the buds severed.

Blackberry. A patch of blackberries in the Vineland district was rather seriously injured by the weevil last spring, about 25 per cent. of the buds being destroyed. In the row next to an adjoining field of strawberries about 75 per cent. of the buds were severed. It was noted that frequently the weevil severed the cluster stem and thus, at one stroke, destroyed several buds.

As a general rule, however, weevil injury to the blackberry is negligible.

Roses. Mr. Bartlett, an Oakville fruit grower, observed the weevil—an insect with which he is very familiar—severing the buds of his rambler roses.

Life History.

Summary. The winter is passed in the adult stage, probably under vegetation and rubbish, in waste and bush lands adjoining the strawberry fields. In spring the insects leave their winter quarters and appear on the strawberry plants about the time the first buds are forming. By means of her slender snout the female weevil punctures the blossom buds, and deposits her eggs singly in the interior of the buds. After depositing an egg she then crawls down the blossom stem and cuts it so that the bud either falls immediately, or is left hanging for a few days, by

a thread. Within the severed buds the whitish grubs which hatch out from the eggs, feed on the pollen and other interior parts. They become mature in about two weeks, pupate, and emerge as adults during the latter part of June and throughout July. The new adults feed for a short time on the pollen of various flowers and, then in midsummer, they seek their hibernating quarters. There is only one generation a year.

The Adult.

Description. Oval, robust, brownish-red to blackish, thinly clothed with whitish pubescence, condensed on a medium line of the thorax and scutellum; elytra dark red, the denuded fascia and scutellar space darker. Antennal grooves directed against the eyes, funicle seven-jointed; antennae dull yellow, club darker. Beak longer than the head and thorax, slender, feebly curved, striate and punctate on the sides, carinate above. Thorax wider at the base than long, sides feebly rounded, narrowed towards the apex; disc densely and rather coarsely punctate. Elytra one-fourth wider at the base than the thorax, one-half longer than wide; striae rather deep, their punctures large, close set; intervals convex, finely punctulate. Ventral segments nearly equal, the third longer than the fourth; pygidium convex, not grooved. Front femora with one tooth, hind tibiae with a short spine at the tip, claws armed with an acute tooth. Length, 2-3 mm. (Adapted from Blatchley).

Emergence in Spring and Habits. The weevils appear in strawberry fields in May, about the time the first buds are formed. Last spring they were first observed in the Vineland district on May 14th. At this time the buds of Senator Dunlap were in evidence, but the buds of Williams had not yet been produced.

The insects eat out holes in the buds and feed on the pollen within. Often several punctures are made in a single bud, so that when the blossom opens the petals present the appearance of having been shot full of holes. The weevils also feed on the stamens of open blossoms and occasionally they eat out holes in the foliage.

So far as we could judge strawberry weevil adults are capable of flying only a few feet.

Egg Laying. In ovipositing the female chews a small hole through the bud, inserting the snout to the base. She then turns around, locates the puncture with her ovipositor, and deposits the egg within—usually among the stamens. In observing this process of oviposition we noted that sometimes two holes would be made, but that only one egg would be laid in the bud. After ovipositing the weevil crawls down the stem and cuts it, so that the bud either falls immediately, or, as is more commonly the case, is left hanging by a mere thread for a few days. The stem may be severed at the base of the bud, or further down. Infrequently the stem of the cluster may be severed.

In the field the adults were observed ovipositing first on strawberry, and later on blackberry and raspberry from May 14th to June 26th. However, it should be stated that by the time the raspberry buds appeared most of the adults had died.

The reproductive capacity of the female was not determined.

Effect of Cold Weather on the Weevil. This spring it was observed that during the cold, wet spell of weather prior to May 19th, the weevils were comparatively inactive, and little injury was done to varieties such as Glen Mary, which were in full bud during that period.

The Egg.

The egg is translucent, broadly oval, and is about 1/50″ in length. As previously stated, it is deposited within the bud and usually adheres to the stamens or pistils.

Duration of Incubation. In experiments with 100 eggs from May 28th to June 6th the duration of incubation varied from four to eight days, the average being six days.

Mortality. In experiments with 65 eggs from May 28th to May 31st the mortality was 14 or 21.4 per cent.

The Larva.

Description. Length, extended, slightly over 2-mm. Color, whitish-sulphurous, often mottled with blackish. Eyes sub-translucent, yellowish: mouth parts brown, lighter below. Thorax less roughened than the abdomen, of three

Adult of the Strawberry Weevil.

Strawberry bud opened to show egg of the Strawberry Weevil within.

distinct segments; narrow dorsal anterior margin of the first segment brownish. Legs wanting, but represented by six fleshy protuberances, each bearing three bristles, the middle one longer and slightly blackish; between the first pair of protuberances a narrow brownish stripe. Abdomen below more translucent, flattened, the sides produced slightly as a longitudinal fold. Above, the abdomen is deeply rugose; there are eight complete folds commencing at the lateral fold, each bearing two lateral, two sub-lateral and two dorsal hairs; between these, on each side a shorter fold, extending from the lateral fold to one-third the upper curve, and a second dorsal fold, commencing immediately before the dorsal termination of the lateral fold. The dorsal fold bears four hairs, the lateral, two. All the abdominal hairs are without color. Behind the thorax the abdomen is naturally curved beneath, so that the distal end rests below the thorax. Abdomen gradually tapering to the sub-apical segment, which bears the posterior respiratory organs beneath a sub-apical fold. Respiratory organs not at all projecting: a slender,

brownish-yellow transverse line runs across them. Last segment tapering, subconical, on each side with a very narrow yellow longitudinal line, from the base to near the tip; the extreme tip yellowish.

HABITS. Within the severed bud the larva at first feeds on the pollen. Pollen, however, is not absolutely necessary for its sustenance, as is shown by the fact that we reared a few adults from buds of Sample, a pistillate variety. The grub feeds on the other interior parts of the bud and eventually bores its way into the receptacle, forming here an enclosed cell, the entrance to which is plugged with closely packed excreta.

EFFECT ON LARVA OF DRYING OUT OF BUD. In cases where the buds persist on the plants or dry out on the soil, the majority of the larvæ die. Last season only 11 adults were reared from 180 dried out buds.

DURATION OF LARVAL STAGE. The average duration of the larval stage of 96 grubs was 13 days, the maximum and minimum periods being respectively 16 and 11 days.

Work of Strawberry Weevil. Note the severed buds and punctured petals.

THE PUPA.

Pupation takes place within the bud. The pupa is creamy white, sometimes mottled with black. All the appendages of the adult are apparent.

DURATION OF PUPAL STAGE. In experiments with 90 pupae the maximum, minimum and average periods of pupation were respectively, 18 days, 6 days and 10 days.

FURTHER NOTES ON THE ADULTS.

EMERGENCE FROM BUDS. According to observations made during the past two years the adults commence to emerge from the buds about June 20th, and continue to emerge throughout the greater part of July.

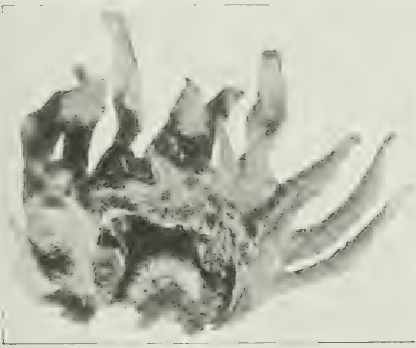
HABITS AND FOOD PLANTS. In the insectary the newly emerged adults fed very freely upon the leaves of strawberries. On some of the plants practically all the foliage was devoured—little more than the bare ribs being left. In the strawberry fields, however, very few beetles were found attacking the foliage, and no

case of skeletonizing of the leaves was observed. Prior to July 11th the weevils were noticed only in strawberry patches. On that date, however, large numbers were found feeding on the flowers of milkweed (*Asclepias*) there being from twenty to seventy on each head. Later on the weevils were taken on the leaves of golden rod, and on the bloom of Canada Mint (*Mentha arvensis canadensis*), Catnip (*Nepeta cataria*), and Heal-all (*Prunella vulgaris*).

Slingerland and Crosby state that the weevil feeds on the flowers of wild bergamot (*Monarda fistulosa*); and Dr. Hamilton* mentions that it was taken feeding on the leaves and flowers of basswood (*Tilia*).

HIBERNATION. The beetles apparently go into hibernation in mid-summer. After the second week in August we found no more weevils feeding on flowers, nor did we find out where the insects went. Rubbish and long grass in the neighborhood of strawberry fields were searched, but no weevils were located.

According to Slingerland and Crosby the insects hibernate "under rubbish, particularly in wood lots or hedgerows adjoining strawberry fields." In Minnesota



Strawberry bud cut open to show the Strawberry Weevil grub feeding within.

the weevils have been found snuggled down about the base of strawberry plants, and in New Jersey they have been found in woodlands adjacent to strawberry fields resting upon the upright stems of a common moss.

METHODS OF REARING.

Pill boxes were used for rearing the weevils from the egg to adult stage. A small amount of soil was placed in the box and kept slightly moist. Too much moisture, or too little, resulted in many cases in the death of the larvæ. The buds were secured in the field or from potted plants, and only buds which were observed being cut by the adults were used. In examining the bud, the sepals and petals were carefully raised, so as not to disturb the grub. It was found that this seldom resulted in any apparent injury to the grub, and it did not appear to deter its development. Where only the numbers developing from cut buds was desired, the buds were placed in a flower pot half filled with moist soil and covered with cheesecloth.

* Can. Ent. XXIV., p. 41.

Control.

The excellent results secured in New Jersey in the control of the strawberry weevil by the use of a dust preparation composed or powdered arsenate of lead and finely ground sulphur led us to give this remedy a trial. Two mixtures were tested (1) 100 sulphur, 20 arsenate of lead, and (2) 90 sulphur, 10 arsenate of lead.

Two strawberry fields at Oakville were treated by the junior writer, and one plantation at Vineland was dusted under our supervision. In addition to these a considerable number of strawberry patches in the Oakville and Niagara districts were treated by their owners. The applications were made by means of: (1) a Monarch duster, (2) a home-made twirler,* and some of the growers used cheesecloth bags.

The dust was applied, weather permitting, as soon as the weevils were found in large numbers. The Bartlett patch at Oakville, and part of the Church patch at Vineland, were dusted twice on account of the first application being washed off by rains, but all the others received only one application.

Results.

W. Bartlett, Oakville. The weevil has been injurious to Mr. Bartlett's strawberries for a number of years and this spring the adults were again very abundant in his patch and threatened to cause serious loss. The two dust mixtures mentioned above were tested and two applications were made.

Results. No more than 5 per cent. of the buds in the whole patch were destroyed and Mr. Bartlett picked the largest crop of berries he had ever harvested. No marked difference was noted between the rows dusted with the 100:20 mixture and those with the 90:10.

As this was the main experimental patch we arranged to leave an adjoining berry patch untreated as a "check." However, Mr. Bartlett found the weevil hard at work in our "check" patch, and decided very suddenly that he was more interested in dollar and cent returns than in experiment results, and he gave what was to have been our "check" patch a heavy coat of dust.

R. Burton, Oakville. Last year (1918) at least 75 per cent. of the buds were destroyed in Mr. Burton's two-acre patch of Glen Mary strawberries. The two dust mixtures were tested this year and only one application was made.

Results. Here again there was no difference in the amount of injury between the rows dusted respectively with 100:20 and 90:10. Throughout the whole of the patch no more than 10 per cent. of the buds were destroyed, and at least half of this injury was done before the dust was applied.

It should be mentioned that in our estimation this particular experiment was of little value because in all cases which came under our observation this year, the variety, Glen Mary, escaped serious injury.

S. Church, Vineland. Last year over 50 per cent. of the buds in Mr. Church's patch were destroyed, and this spring the weevils were present in large numbers. Several rows of early berries were dusted twice. However, the main patch of Williams only received one application. Only the one dust, the 90:10, was used.

*The frame work of the holder was made of a wire ring 9"-10" in diameter and two bent wires crossed at right angles. This was lined with fine wire cloth, twenty or more meshes to the inch. A bent branch was used as a handle.

RESULTS. An insignificant percentage of the buds were destroyed in this patch and a splendid crop of berries was harvested—about 250 crates per acre. In a patch about ¼ mile from Mr. Church's at least 60 per cent. of the buds were destroyed by the weevil and the yield was only 100 crates per acre.

RESULTS IN OTHER STRAWBERRY PATCHES.

In every strawberry field where the dust was put on at the right time excellent control was obtained. All the growers who used the dust remedy expressed themselves as being well satisfied with the results.

INSECTS OF THE SEASON IN ONTARIO.

W. A. ROSS, DOMINION ENTOMOLOGICAL LABORATORY, VINELAND STATION, AND L. CAESAR, ONTARIO AGRICULTURAL COLLEGE, GUELPH.

The past year was a notable one from the entomologist's point of view. The mild winter of 1918-19 and the hot, dry summer were very favourable to insect life, and consequently injurious insects of many kinds were numerous.

Fig. 1.—Young apples deformed by nymphs of the Mullein Leaf Bug (*Campyloma verbasci*).

ORCHARD INSECTS.

It is worth while noting here that the carefully and regularly sprayed apple orchards were practically the only ones which had crops of fruit this year.

CODLING MOTH (*Cydia pomonella*). This well-known pest was very much more abundant than usual and caused great loss in the warmer parts of the Province where the percentage of second brood is largest. Some unsprayed orchards in the Niagara District had almost every apple infested. Orchards, well sprayed this year, but which in preceding years had been neglected or poorly sprayed had as high as 50 per cent. "sideworm injury." On the other hand, orchards in districts that had been well sprayed for several years suffered little injury, thus showing the cumulative effects of good spraying.

CIGAR CASE-BEARER (*Coleophora fletcherella*). This species is usually of comparatively small importance, even in unsprayed orchards, but this year it was present in very large numbers and made the foliage of unsprayed trees very tattered and unsightly.

BUD MOTH (*Eucosma ocellana*). This species was somewhat more abundant than usual, especially in Norfolk County.

PEAR LEAF BLISTER MITE (*Eriophyes pyri*). This well-known pest has for several years been held in check by unknown natural factors, but during the past two years it has increased to a very marked extent in many orchards which have not been receiving the so-called dormant application of lime-sulphur. The present indications are that the blister mite will again have to be reckoned with as a first-class orchard pest.

THE MULLEIN LEAF BUG (*Campyloma verbasci*). A small mirid,* which occurs throughout the Province on mullein, catnip, potatoes and several other plants, was found attacking apples this year in two orchards in Norfolk County. Baldwin, Roxbury Russet and Spy were freely attacked and on a few of the infested trees 75 per cent or more of the apples were more or less injured by the bugs feeding on them. It was not uncommon to see one to seven of the little green nymphs on a single apple.

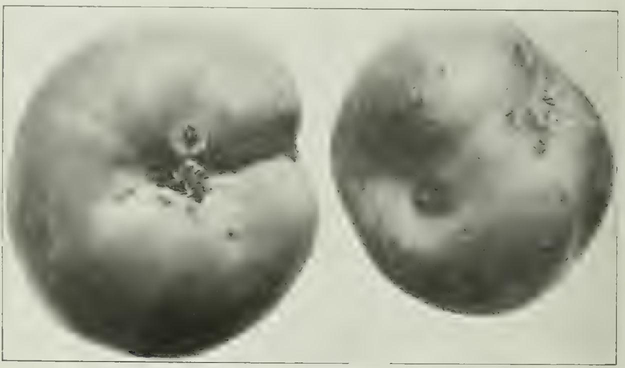


Fig. 2.—Mullein Leaf Bug injury on mature apples.

Conspicuous brown or sometimes blackish corky warts formed at the spots where the punctures were made. In most cases there was only one or two such scars to an apple; in others a ring of them almost encircled the apple; and in others several, close together on the one side, caused the fruit to be lopsided.

All the puncturing was done by the nymphs while the apples were still small —not more than one-half to two-thirds of an inch in diameter. (According to our observations, the adults do not attack the fruit but they do feed very freely upon the leaves and wood of the new growth, and are specially fond of the water-sprouts.)

The nymphs are light green in color and are very small, being, even in the last instar, only about 2 mm. in length. The adults vary in color from greenish to brown, and average about 3 mm. in length. The life history of this species was not worked out, but from the fact that on June 12th most of the nymphs were in the last instar and a few had transformed into adults it would appear

*Species determined by E. P. Van Duzee.

that these must have hatched from the eggs, at the latest, by the time the blossoms appeared.

At the time of picking it was found that most of the apples had almost completely outgrown the plant-bug injury save for small brown or blackish elevated scars on the surface. Badly punctured apples, however, were greatly deformed by the failure of the injured areas to grow. The percentage of blemished apples could not be determined because the fruit was thinned early in the season and the worst specimens picked off.

THE SAN JOSÉ SCALE (*Aspidiotus perniciosus*) has not yet regained the position it held prior to the winter of 1917-18. Both last year and this year it was difficult to find many badly infested trees. The insect, however, is gradually increasing in its old haunts—neglected orchards.

THE APPLE LEAF SEWER (*Ancylis nubeculana*) was present in most orchards this autumn in moderate numbers. It is usually a rare insect in Ontario.

Fig. 3.—Apple leaves folded by the Apple Leaf Sewer.

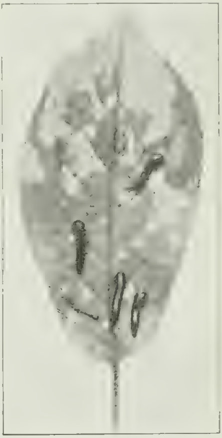


Fig. 4.—Pear Slugs skeletonizing cherry leaf.

LESSER APPLE WORM (*Enarmonia prunivora*) was, as last year, very scarce.

PEAR SLUG (*Eriocampoides limacina*). The outbreak of pear slug was repeated this year on an even larger scale than that of 1918. The foliage of thousands of pear and cherry trees throughout a large part of the Province was destroyed, and in the case of early Richmond cherries much of the fruit was rendered worthless. Just as last year, it was the first brood that did nearly all the damage. In a few localities the second brood larvæ were fairly numerous, but in most places they could scarcely be said to have done any injury worth mentioning. The eggs of the second brood were this year, as last, highly parasitized. A few parasites were reared also from the pupae.

ROSE CHAFER (*Macrodactylus subspinosus*). In June hordes of rose chafers appeared in the Simcoe and Fonthill sections and injured apples, grapes and cherries.

Tussock Moth (*Hemerocampa leucostigma*). As forecasted in last year's report, little or no injury was done by this species.

Fall Webworm (*Hyphantria cunea*). The unsightly webs of this species were again very conspicuous throughout the province. However, according to our observations the insect was not so abundant as it was last year.

Plum Curculio (*Conotrachelus nenuphar*). This species was unusually destructive in the Niagara District. It was especially injurious to peaches and was responsible for a large "drop." In a peach orchard at Winona over 50 per cent. of the crop was destroyed by it.

Unspotted Tentiform Leaf Miner (*Ornix geminatella*). This unimportant apple insect was common in some orchards in the Niagara District and Norfolk County.

Fig. 5.—Cherry leaves and fruit injured by the Pear Slug. Note the wizened fruit.

Silver Leaf Mite (*Phyllocoptes schlechtendali*). Practically all the foliage in a block of seedling peaches at the Horticultural Experiment Station, Vineland, was affected with silver leaf. This same disease was quite common in other peach orchards in the Vineland district; and in every case we examined we found it was caused by the mite *Phyllocoptes*. It is of interest to note that according to our observations this mite hibernates under the protection of the bud scales and between the leaf petioles and the base of the bud.

Rose Leaf-hopper (*Empoa rosae*). In late summer and fall myriads of rose leaf-hoppers were present in many apple orchards in the Niagara District and Norfolk County and produced a characteristic mottling of the leaves. In a large infested orchard at Simcoe practically all the foliage became pallid and in

the case of Greening trees the appearance of much of the fruit was spoiled by specks of excrement voided by the hoppers.

On October 17th large numbers of females were observed depositing their eggs on apple—in the bark of the smaller branches and twigs.

Apple Aphids. Exceptionally large numbers of recently hatched nymphs were observed in the spring in most sections of Ontario. Heavy washing rains and insect enemies, however, destroyed such a large percentage of the plant lice that no serious injury was effected.

Pear Thrips (*Taeniothrips inconsequens*). This pest was found only in the orchard in which it was taken last year, and here again it was present in very small numbers.

Fig. 6.—(*a*) A normal peach leaf contrasted with (*b*) a leaf injured by the Silver Leaf Mite.

Fulgorid on Pear (*Ormenis pruinosa*). In a Beamsville pear orchard large numbers of a fulgorid nymph pale green in colour and more or less covered with a white woolly material, were found about mid-July feeding on the water-sprouts. The species was reared and proved to be *Ormenis pruinosa*.

Insects Attacking Grapes and Small Fruits.

Grape Leaf-hopper (*Erythroneura comes*). In view of the abundance of various species of leaf hoppers, notably the rose leaf-hopper (*Empoa rosae*) and the

potato leaf-hopper (*Empoasca mali*) it is of interest to note that the grape leaf-hopper was much less conspicuous than usual in vineyards in the Niaraga District.

Blackberry Leaf-miner (*Metallus bethunei*). This leaf-miner was again very destructive in blackberry plantations in the Burlington and Niagara districts. Egg and larval parasites were much more abundant than last year.

Strawberry Leaf-roller (*Ancylis camptana*). This species was apparently somewhat more general than last year but did comparatively little damage.

Imported Currant Worm (*Pteronus ribesii*). As usual, this sawfly did considerable damage to currants and gooseberries.

Strawberry Root Louse (*Aphis forbesi*). It is worth mentioning that this species, which is so destructive in Illinois and other parts of the United States, was found in small numbers in a strawberry plantation at Bismark.

Imported Currant Borer (*Sesia tipuliformis*). Adults of this species were very abundant about mid-June in some black currant plantations in the Niagara district.

Strawberry Root Borer (*Typophorus canellus*). Adults of this species were common in a strawberry patch at Oakville, but apart from eating out holes in the foliage the insects apparently caused no serious injury.

Raspberry Sawfly (*Monophadnus rubi*). This well-known pest of the raspberry was conspicuous by its absence.

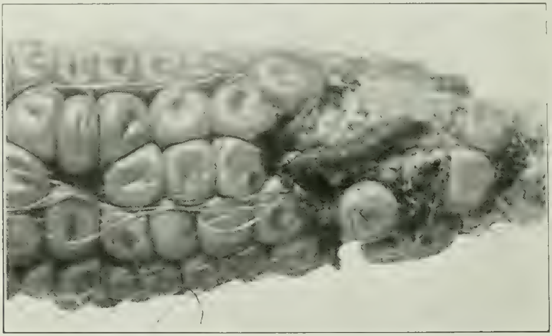


Fig. 7.—Corn Ear Worm and its work.

Insects Attacking Vegetables.

Cabbage Maggot (*Chortophila brassicae*). This insect varied greatly in numbers and destructiveness in the different districts. At Vineland, Burlington, Guelph, London and other parts of southern and western Ontario it did almost no harm except to radishes, but at Ottawa and to a lesser extent in Norfolk County it was abundant and destructive.

Onion Maggot (*Hylemia antiqua*). The onion maggot did much harm at Dixie and in several other localities, but at Burlington and Leamington, as last year, was not of much importance.

Imported Cabbage Worm (*Pieris rapae*). This insect caused much injury in cabbage and cauliflower fields all over the western and southwestern parts of the Province.

DIAMOND-BACK MOTH (*Plutella maculipennis*) was very conspicuous in fields of cabbage.

CORN EAR WORM (*Heliothis obsoleta*). This insect attacked the ears of sweet and field corn in many localities this fall. Infested ears were received by the writers from Welland, Lincoln, Wellington and Lambton Counties. Injury was practically confined to late planted corn. In Welland County it was observed that Dent corn was injured more than Flint.

TOMATO OR TOBACCO WORM (*Phlegethontius quinquemaculata*). This species was present in exceptionally large numbers in tomato and tobacco fields in the Leamington district and other parts of western Ontario. It was also common in Norfolk County.

PEA APHIS (*Macrosiphum pisi*). This plant louse was again very destructive to peas grown for the canning factories in Prince Edward County and to a lesser extent in Norfolk County. Field peas were also injured in Lincoln County.

CUTWORMS. Quite a few complaints were received regarding cutworm injury to cabbage, tomato and corn. What we took to be the dingy cutworm *Feltia ducens* was injurious to cabbage at Vineland about mid-May. The variegated cutworm was moderately abundant throughout the Burlington district and was apparently the cause of most of the holes eaten in tomatoes in September.

ASPARAGUS BEETLES (*Crioceris asparagi and C. 12-punctata.*) The two species were very common and injurious in the Niagara district. At Vineland the chalcid parasite (*Tetrastichus asparagi*) was again observed.

COLORADO POTATO BEETLE (*Leptinotarsa decemlineata*). The beetles came through the winter in large numbers and caused much damage early in the year to potatoes and tomatoes. According to reports received, the "Friendly Perillus" was unusually effective as a check.

CABBAGE APHIS (*Aphis brassicae*). This louse was very abundant in late summer and fall on cabbage, cauliflower and turnips and caused considerable injury. However, due to the effective work of the parasitic and predaceous enemies, the outbreak did not reach the alarming proportions we anticipated. It is of interest to note that one of the most important insect checks of this species was the larva of *Aphidoletes fulva*.

RED HEADED FLEA-BEETLE (*Systena frontalis*). This species was unusually prevalent on beans.

BLACK STINK-BUG (*Cosmopepla bimaculata*) was remarkably abundant this year on grains but so far as we could see caused no injury. Mr. MacLellan, Ontario Vegetable Specialist, reports that during the summer this species killed the tips of asparagus plants in a truck garden at London.

POTATO LEAF-HOPPER (*Empoasca mali*) was remarkably abundant on potatoes and beans throughout the Province. It was generally credited with being responsible for all the leaf burn which was so prevalent on early potatoes. However, we are not at all sure that this claim was wholly correct.

In this connection the following preliminary experiments conducted at the Dominion Entomological Laboratory, Vineland Station, by Mr. Robinson are of interest. Three cheesecloth cages each large enough to cover three plants were put over potatoes growing in the field in June before there were any signs of leaf-burn. Large numbers of leaf-hoppers were introduced into two cages and the third was used as a check. None of the plants were watered. Tip-burn developed on the potatoes in all three cages, and, strange to say, just as rapidly on the check plants as on the infested ones. These experiments were duplicated in the insectary

with potted potato plants which were kept well watered. Here the results were quite different: leaf-burn developed on the infested plants whereas the check (one plant) showed no indications of it at all. The interpretation of these results would appear to be that two factors caused the leaf-burn this year, namely the drought (probably the more important) and the leaf-hopper.

ONION THRIPS (*Thrips tabaci*). This pest exacted a very heavy toll this year from the truck gardeners of Ontario. In the counties of Kent and Essex the thrips, aided by the hot, dry weather, reduced the onion crop to one-third of a normal yield.

TARNISHED PLANT BUG (*Lygus pratensis*). This well known bug was present in exceptionally large numbers this year and caused a considerable amount of damage especially in gardens. Asters and dahlias were attacked so freely that in many sections they were a complete failure. At the Dale Estate, Brampton, only about one thousand flowers were cut from twenty thousand plants. At Kingston spinach grown for seed was injured to such an extent that the plants failed to produce any seed. Plant bug injury, in the form of blasted compound leaves was common in potato fields. The black joint disease of celery caused by the bugs feeding at the joints was prevalent throughout the province. It should be mentioned here that Mr. MacLennan, Ontario Vegetable Specialist, is positive that the tarnished plant bug is the chief agent concerned with the spread of bacterial soft rot or black heart of celery.

POTATO FLEA-BEETLE (*Epitrix cucumeris*). In June this species and its work were conspicuous in potato patches in the Niagara district. It was also injurious to tomatoes.

THE THREE-LINED LEAF-BEETLE (*Lema trilineata*) was unusually common on potatoes in the Niagara peninsula.

THE STRIPED CUCUMBER BEETLE (*Diabrotica vittata*) occurred in more than usual numbers in parts of Norfolk County, but around Burlington and in many other localities it was scarce.

INSECTS ATTACKING FIELD CROPS.

CLOVER LEAF WEEVIL (*Phytonomus punctatus*). The larvæ of this pest occurred in exceptionally large numbers in parts of the Niagara peninsula and southwestern Ontario. In Norfolk County a whole field of clover was ruined. However, in most fields serious injury was prevented by the almost complete destruction of the grubs by a fungus disease.

CHINCH BUG (*Blissus leucopterus*). The chinch bug appeared in large numbers this summer in Gainsboro' Township, Lincoln County, and caused a considerable amount of alarm among the farmers. The centre of infestation was at the village of Bismark and the infested area extended, roughly speaking, about two miles around the village. Meadow grasses, particularly timothy, were in some instances killed outright. Oats were injured to a considerable extent. One six-acre field was completely destroyed and in another field a strip about the width of a drill was also killed outright. However, as a general rule the infested oats did not die but ripened prematurely and produced little or no grain. Some damage was also done to corn.

Late in September we found large numbers of the adults destroyed by the chinch bug fungus (*Sporotrichum globuliferum*). The percentage of mortality varied from 25 per cent. to 75 per cent. in the fields examined.

We hope and expect that the wet weather we have had this fall along with the coming winter will reduce the hibernating adults to insignificant proportions.

CRAMBID ATTACKING WHEAT (*Crambus caliginosellus*).* In the seven-acre field of wheat in Wainfleet Township, Welland County, over 60 per cent. of the wheat was destroyed by a crambid or sod-worm. Because of the very wet spring this particular field was not worked until August and as a result had been covered with weeds and grasses most of the year. One-half of the field was ploughed about August 1st. This part was not seriously injured. The other half was not ploughed until the middle of August and in this the wheat was so badly damaged that it had to be resown.

CLOVER SEED CHALCIS (*Bruchophagus funebris*). Judging from samples of seed sent in last winter from Kent County, this insect must have been very abundant there in 1918. One correspondent claimed that much of the seed produced in Kent County was destroyed by this tiny insect.

Fig. 8.—Nymphs of Chinch Bug (much enlarged).

Fig. 9.—Showing the long-winged and short-winged forms of the Chinch Bug adult.

GLASSY CUTWORM (*Sidemia devastatrix*). This cutworm caused some alarm in Middlesex County in mid-June by cutting off wheat plants. The total loss, however, was not great.

HESSIAN FLY (*Mayetiola destructor*). So far as observed, this insect did not cause any appreciable injury in any district. In several fields approximately 5 per cent. of the plants were attacked.

MISCELLANEOUS.

WARBLE FLIES (*Hypoderma bovis* and *H. lineatum*) threatened to be very numerous judging by the great numbers of warbles seen on the backs of cattle in the spring. Fortunately the danger so far, at least, as the heel fly was concerned did not materialize, and very few complaints of cattle gadding were received.

SPRUCE GALL LICE (*Chermes abietis* and *C. similis*). Galls caused by these insects were somewhat more conspicuous than they have been for several years. There are evidently powerful natural factors keeping these insects under control.

GRASSHOPPERS. Few complaints were received regarding grasshoppers or locusts. In the Smithville district, however, these pests were more abundant than they had been for many years. Garden crops, alfalfa and oats were very freely attacked.

COTTON WORM (*Alabama argillacea*). Moths of this species visited many parts of Ontario this autumn and attracted considerable attention.

*Species determined by Dr. McDunnough.

ROSE MIDGE (*Dasyneura rhodophaga*). We regret to report that this destructive midge has made further inroads into Ontario. It is now present in six large greenhouses: three in Toronto, one at Grimsby, one at Port Dover, and in the large Dale Estate at Brampton. In every instance the pest was brought in on rose stock imported from the United States.

Fig. 10.—Injured rose bud opened to show Rose Midge maggots feeding within. (Enlarged three times.)

TRUMPET VINE MIDGE (*Itonida tecomiae*). During the past two years trumpet vines at Guelph have been seriously injured by a white cecidomyiid larva which curls and distorts the leaves. Badly infested leaves turn brown and die and in this way much of the young growth may be destroyed. We reared the adult and the species was determined by Dr. E. P. Felt, as *Itonida tecomiae* Felt.

REMARKS ON THE ANCESTRY OF INSECTS AND THEIR ALLIES.

G. C. Crampton, Massachusetts Agricultural College.

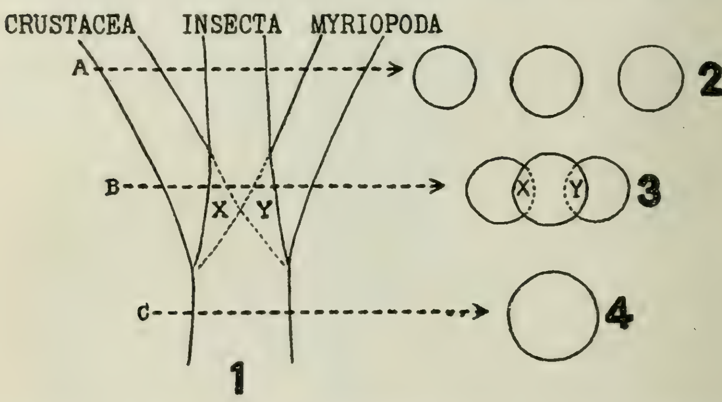
It has been a matter of considerable surprise that so much time and attention have been expended upon the subject of the evolution of mammals, reptiles, and other vertebrates, to the practical exclusion of the consideration of the development of the lines of descent of the insects, Crustacea, "Myriopoda," and other arthropods, especially since the study of the latter forms involves no great outlay in the matter of collecting expeditions, equipment, housing facilities, etc., as is the case with the study of the vertebrate groups. In fact, the arthropods offer unrivaled opportunities for the study of evolution, including, as they do, the greatest number of species of living things, as well as a marvellous range of modifications in adaptation to varied environmental conditions, and a height of development of the psychic faculties (social instincts, etc.) unapproached elsewhere save in the group Mammalia. In addition to these advantages, the ease with which many of them can be obtained, and the fact that no elaborate equipment or technique is necessary for studying their external anatomy brings the group within the reach of practically everyone, and it is most earnestly to be hoped that so fertile a field for research will soon attract a number of investigators commensurate with its great possibilities and its importance from the standpoint of evolution.

Not only has this potentially rich field of research been sadly neglected, but even the meagre investigations which I was able to carry out during the past summer very quickly demonstrated that the prevalent conceptions concerning the meaning of the parts in insects (as interpreted from the standpoint of a comparison with the structures of Crustacea and other arthropods) are in many cases wholly erroneous. Thus the oft repeated statement that the "superlinguae" or "paraglossae" on either side of the hypopharynx of insects represent the first maxillae or "maxillulae" of insects is quite wrong, since the structures in question clearly correspond to the so-called paragnaths or structures on either side of the median ridge (corresponding to the hypopharynx or tongue of insects) in the mouth region of certain Crustacea—and the "superlinguae" or "paraglossae" therefore cannot be regarded as the appendages of a distinct "superlingual" segment in insects, as Folsom has claimed is the case in these forms. The investigations of all embryologists other than Folsom have clearly shown that the "superlinguae" are not appendages of a distinct segment; but practically all recent entomologists have been led astray in a matter which could easily have been righted had they but taken the trouble to examine the corresponding parts in the lower insects and Crustacea. Furthermore, a study of the Crustacea clearly demonstrates that the first maxillae of insects correspond to the first maxillae of Crustacea, while the second maxillae of insects (i.e. the halves of the labium) correspond to the second maxillae of Crustacea, and the head of an insect is therefore comprised of but six (not seven) segments, as embryology has long indicated to be the case.

The statement that the parts of an insect's mandible are comparable to the parts of the maxillae, which has received universal acceptance in the textbooks dealing with the subject, is at once seen to be impossible when one compares a series of crustacean mandibles with those of insects, since such a comparison very clearly shows that the insect's mandible represents the *basal segment alone* of the corresponding appendage in the Crustacea, while the maxillary galea and lacinia

represent processes of *two* distinct basal segments of an appendage, whose terminal portion forms the palpus of the maxilla. Furthermore, a comparison with the parts of the Crustacea very clearly shows that the universally accepted opinion that an insect's maxilla represents a "biramous" appendage is wholly false (the galea and lacinia being merely processes of two basal segments of an appendage whose endopodite alone forms the maxillary palpus), and the attempt on the part of several investigators to compare parts of an insect's mandible (as well as the parts of the maxillae) to the endopodite and exopodite of a crustacean appendage would never have been made if they had but taken the trouble to compare a series of crustacean mandibles with those of insects.

Since the second maxillae of Crustacea are homologous with the second maxillae of insects, which unite to form the labium in the latter forms, it is impossible to homologize the united poison claws of chilopods (which represent the first maxillipedes of Crustacea, and therefore occur behind the second maxillae)

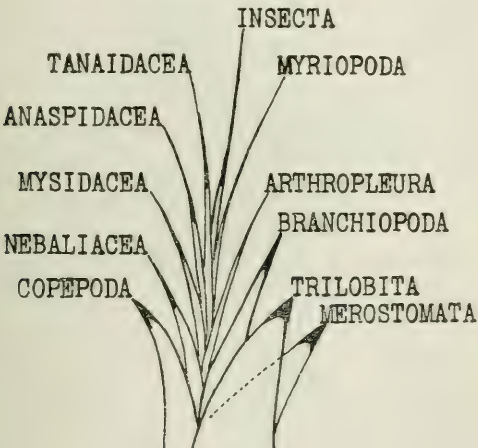


with the second maxillae or labium of insects, as many investigators have sought to do, and the erroneous claim that the underlip (united first maxillae) of diplopods is formed by the fusion of two pairs of appendages, is seen to be untenable when one compares the structures in question with the underlip of certain isopods (which here, however, is formed by the united first maxillipedes) in which the corresponding parts are clearly seen to belong to but *one* pair of appendages, as embryology has shown to be the case all along, although most anatomists have totally disregarded its evidence.

From a comparison with the parts in the Tanaidacea and other Crustacea the cerci of insects are seen to represent one of the rami of the uropods on either side of the telson, and the meaning of the styli attached to the basal segments of the abdominal limbs of the Machilidae and other primitive insects is at once apparent when one examines the reduced abdominal appendages of the Isopoda and other Crustacea. Indeed, the study of the parts in the Crustacea has furnished the key for the interpretation of the corresponding parts in insects in practically every instance, as I am hoping to show in a series of articles soon to be published upon the subject, and these facts are referred to at this point merely to show that

a study of this most promising field has been grossly neglected, and even the few observations which have been made are for the most part badly in need of revision!

Despite Handlirsch's claim to the contrary (and his opinion has gained a surprisingly wide acceptance among recent writers), a comparison with the Crustacea and "Myriopoda" should convince anyone that the Apterygota rather than the winged insects, are the most primitive representatives of the class Insecta, and by no possible stretch of the imagination can the Apterygota be regarded as degenerate winged forms, as Handlirsch would have us believe! Instead of upholding Handlirsch's fantastic view that winged insects can be directly derived from Trilobites without the intervention of apterygotan forms, and a long series of intermediate stages, a comparison of the parts in insects, "Myriopoda,"



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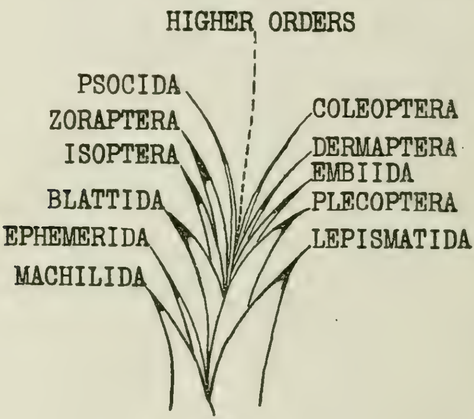
Crustacea, Trilobita, and the Merostomata, would clearly indicate that between the type of mouthparts, head capsule, and other structures found in the Trilobita, and those of even the most primitive representatives of the group Insecta, there must have occurred a long series of intermediate stages leading through the lower Crustacea, the lower Malacostraca, and the ancestors of the higher Crustacea (i.e. Isopoda, Tanaidacea, etc.) before the insectan types of structures were developed; and one cannot help but suspect that Handlirsch and his followers are either wholly ignorant of the absolutely obvious and patent evidence afforded by a study of the parts in the Crustacea and their allies, or they have deliberately ignored the tremendous array of facts whose evidence should have convinced them of the error of their contentions.

It is the fashion nowadays to consider the "Myriopoda" as the nearest representatives of the common ancestors of pterygotan and apterygotan insects; but here again, a comparative study of the structures in the Crustacea and certain of the Apterygota such as *Machilis* and *Lepisma* should have been made before

such a view was promulgated, for such a study clearly indicates that the lines of development lead from the common ancestors of the isopods, Tanaidacea, Cumacea, and other Crustacea, through those of the Machilidae and Lepismatidae to the ancestors of the most primitive representatives of the winged insects such as the mayflies (Ephemerida) and stoneflies (Plecoptera). The structural resemblance between the mayflies and the Machilidae, or that between the Plecoptera and the Lepismatidae, is most striking, and the lines of descent of the Machilidae and Lepismatidae clearly lead back to Crustacea-like, rather than to "Myriopod"-like ancestors. It must be admitted, however, that certain other apterygotan insects such as the Campodeidae, Protura, etc., are extremely closely related to certain "Myriopoda" such as *Scolopendrella, Pauropus,* etc., but the lines of descent of these forms appear to represent merely side issues of the main trunk which leads to the evolution of the pterygotan insects (unless such insects as



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Campodea, Japyx, and other insects of the apterygotan order Rhabdura, are near the forms giving rise to the line of development of the pterygotan order Dermaptera, as I formerly held to be the case—but a further study of the insects in question has tended to discredit this view).

Although the main lines of descent of the pterygotan insects appear to avoid the "myriopodan" side of the ancestry of insects and to lead back more directly to Crustacea-like forms through ancestors resembling the Machilidae and Lepismatidae, the dual relationship of apterygotan insects to the "Myriopoda" as well as to the Crustacea, cannot be ignored. This dual relationship is expressed graphically in Fig.1. As is shown in the figure, the lines of descent of the "Myriopoda," Insecta, and higher Crustacea (Isopoda, Tanaidacea, Cumacea, etc.) taken at the level "A," are quite distinct (as is represented by cross sections of these lines of descent shown in Fig. 2); but at the level "B," where the lines of descent begin to converge as they approach their common source, it is evident that the members of the three groups come very close together, and those insects occupying the

"hereditary area" labeled "X" in Fig. 1, would naturally be expected to resemble the Crustacea quite closely, since the territory which they occupy is contiguous to that of the higher Crustacea. Similarly, those insects which occupy the "hereditary area" labeled "Y," would greatly resemble the "Myriopoda," since the territory which they occupy is contiguous to that of the "Myriopoda." Cross sections of the three lines of descent at the level "B" would be represented as three intersecting circles (Fig. 3), each of which, taken separately, demarks a distinct group (Crustacea, Insecta and Myriopoda); but the intersecting circles have a certain amount of territory in common, and those insects in the area labeled "X" (Fig. 3) being next to the Crustacea, would naturally have much in common with the Crustacea (left hand circle), while those insects in the area labeled "Y" being next to the "Myriopoda" (right hand circle) would naturally have much in common with the "Myriopoda." If we trace the lines of descent back to the level "C" (Fig. 1) they are seen to merge in a common "crustaceoid" ancestry; and a cross section at this level would represent the circles as completely coinciding (Fig. 4). It is thus readily comprehensible that there may be a dual relationship between the Insecta and higher Crustacea, on the one hand, and between the Insecta and the "Myriopoda" on the other—as we are forced to conclude is the case, from a study of the anatomy and embryology of the forms in question. This may indicate that the group Insecta is a polyphyletic one, and although I have been loath to accept this view, I can see no escape from the conclusion that insects are very closely related to both the higher Crustacea (Isopoda, Tanaidacea, Cumacea, etc.) and the "Myriopoda."

Since it is quite evident that the lines of descent of the higher Crustacea, Insecta, and "Myriopoda" soon merge in a common ancestry, the question naturally arises as to what these common ancestors were like. That these common ancestors were all of one type is out of the question, for they apparently differed among themselves as much as the Mysidacea, Anaspidacea and other "intermediate Malacostraca" (possibly including Arthropleura also) differ among themselves; and these common ancestors probably resembled all of the forms just mentioned (i.e. the Mysidacea, Anaspidacea, etc.), though it is possible that the Cumacea and Tanaidacea are more like the *immediate* ancestors of insects than are the Mysidacea, Anaspidacea, etc., which are more like their *remote* ancestors.

The Anaspidacea, Mysidacea, and other "intermediate Malacostraca" are in turn derived from ancestors resembling the Nabaliacea and other primitive Malacostraca, and the lines of development of the malacostracan Crustacea have undoubtedly accompanied those of the insects and "myriopods" more closely and for a longer distance than any other forms have done. The primitive malacostracan Crustacea such as *Nebalia* and its allies, exhibit undoubted affinities with the Branchiopoda and Copepoda, and to some extent with the Trilobita also, and they have even preserved some ancestral features in common with the Merostomata, although the latter forms lead off toward the lines of development of the Arachnoidea, and away from the lines of development of the higher Crustacea, Insecta, and "Myriopoda."

The question as to which arthropods have departed the least from the common ancestors of the phylum Arthropoda is an extremely difficult one to answer. The Copepoda, Branchiopoda and Trilobita are among the most primitive known arthropods, and it is quite probable that the first representatives of the group combined in themselves characters common to all three. Thus, for example, the earliest arthropods were in all probability not trilobites alone, but were doubtless

trilobite-branchiopods, trilobite-copepods, etc., having many features in common with all three of these primitive groups, though in many respects the Trilobita have departed as little as any known forms from the ancestral type. It is thus necessary to make composites combining the primitive characters occurring in all of these primitive groups in order to come to the correct conclusion concerning the character of the ancestral arthropods. The Merostomata have also retained many features which must have been present in the ancestral arthropods; but their lines of descent (which apparently sprang from ancestors resembling the Trilobita) lead off toward the arachnoids, which lie in a side line having no direct bearing on the origin of the insectan and myriopodan type of arthropod. The ancestors of the arthropods themselves were in all probability very much like annelid worms, though other forms such as the Onychophora, etc., have retained many features characteristic of the ancestors of the phylum Arthropoda; but a discussion of these forms has no particular bearing upon the question of the nature of the more immediate ancestors of the higher Crustacea, Insecta, and "Myriopoda," and they need not be further considered here. It may be of some interest, however, to indicate briefly the principle lines of descent of the more primitive representatives of the class Insecta, and I have therefore included a diagram giving the lines of descent of those forms which have departed the least from the types ancestral to the higher groups of insects, although, as is also the case with the diagram of the lines of descent of the arthropodan allies of insects, it has been necessary to omit many important groups in order not to make the diagrams too cumbersome and intricate for practical purposes.

LATER DEVELOPMENTS IN THE EUROPEAN CORN BORER SITUATION.

E. P. Felt, State Entomologist of New York.

The last two months have witnessed a considerable extension of infested territory, the most significant being the area in Erie and Chautauqua Counties, New York, some twenty-five miles long, extending from Angola to Fredonia and with a known maximum width of ten miles. There is in addition a small infestation at North Girard, Erie County, Pennsylvania, and the probabilities are that the New York and Pennsylvania areas may be connected by a sparse infestation. In fact, the early corn planted on the light soil south of the lake is a suspicious area and it is impossible at the present time to define closely the extent of the infested territory in this section.

Explorations in the vicinity of the Schenectady area tend to confirm in a general way at least the limits established during the summer. The infestation in Massachusetts and New Hampshire has already been described in detail and requires no further comment at the present time.

A most significant development has been the failure of the European corn borer to produce two broods in the infested area in New York State. This means a very material reduction in the possibilities of injury and it is gratifying to state that in the earlier discovered Schenectady area, a section thoroughly cleaned up last spring, the maximum injury has hardly overrun one per cent. in a few very restricted areas, possibly amounting to five per cent. It is considered advisable for the present to content ourselves with the statement that but one generation

developed last year since there is a possibility, perhaps very remote, that two generations may occur in this area during certain seasons and this condition may, after all, prove to be the normal.

The decidedly disturbing feature is the very sparse, inconspicuous character of the infestation in the western part of the state, a section where the insect has bred in a few localities at least for two seasons. The infestation was brought to the attention of Cornell University authorities through the accidental discovery of a few borers in a stalk, although a farmer in that vicinity had noted the injury the preceding season but had failed to appreciate its significance. In most of the territory, however, a very close examination is necessary to find the borer and these conditions suggest the comparative inefficiency of publicity measures and the great difficulty of organizing a sufficiently thorough scout of the corn fields of America to determine with a reasonable degree of accuracy the limits of the present infested areas.

We have yet to find unquestioned evidence as to the agencies producing these isolated infestations. It looks very much as though railway lines were an important factor, possibly in carrying the moths, since both the eastern and western areas in New York State have good railway connections with the older infested area in Massachusetts.

The occurrence of but one brood in the cooler corn-producing areas of New York State, even if this be normal, cannot be construed as being true of our great southern and warmer corn belt. The sparsely infested areas must be regarded as a real menace to much of the corn crop of America. The most practical method of handling the situation appears to be pushing the publicity campaign as far as practical, systematic scouting of the more suspicious areas so far as they can be determined and a comprehensive campaign of control designed specially to check spread until the economic status of the borer can be determined in this country.

THE ENTOMOLOGICAL RECORD, 1919.

ARTHUR GIBSON AND NORMAN CRIDDLE, ENTOMOLOGICAL BRANCH,
DOMINION DEPARTMENT OF AGRICULTURE.

The collecting season of 1919 does not appear to have provided any marked variation from the preceding year. In the Middle West a continuation of the drought in southern sections was especially favourable to the development of dry-loving insects, more notably Orthoptera, which in some parts increased to injurious numbers. Somewhat similar conditions prevailed in British Columbia and probably to a lesser extent in Ontario. Collecting, generally, was reported to have been good during the first part of the season but later became less so. It is gratifying to report that more attention is being devoted to hitherto neglected orders; as a result a far broader knowledge of the distribution of Canadian insects is being obtained.

During 1919, students of insects in Canada, have, as in previous years, been much assisted in their studies by various specialists, particularly those resident in the United States. To all who have assisted us, we extend our grateful thanks.

LITERATURE.

Among the publications which have appeared during 1919, the following are of interest to Canadian students.

BOWMAN, KENNETH. Annotated Check List of the Macrolepidoptera of Alberta. Published by the Alberta Natural History Society, Red Deer, Alta., 16 pp., February, 1919. In the preparation of this list the author has "endeavoured to provide an epitome of what has been accomplished by students of this order within the province to date, as an aid, not only to present workers but those who will follow after." We were very glad indeed to receive this list. It is a very useful contribution.

CANADIAN ARCTIC EXPEDITION (1913-1918) INSECT REPORTS. These reports on the insects of the various orders collected by members of the expedition were published in 1919, with the exception of the one on the Lepidoptera which was issued early in January, 1920. They comprise Vol. III of the Report of the Canadian Arctic Expedition. Ottawa: J. de Labroquerie Tache, Printer to the King's Most Excellent Majesty.

Part A: COLLEMBOLA, by Justus W. Folsom, 29 pp., 8 plates. Twelve species are discussed, three of which are described as new. The plates illustrate structural characters.

Part B: NEUROPTEROID INSECTS, by Nathan Banks, 5 pages, 1 plate. Five species are definitely determined, two of which are described as new. Two additional generic determinations are given. The plate illustrates genitalia of the two new species and views of other male characters.

Part C: DIPTERA, 90 pp. Crane flies, by C. P. Alexander; Mosquitoes by H. G. Dyar, and other Diptera by J. R. Malloch. In the first portion on the Tipulidae, sixteen species are reported upon. Of these, thirteen are new. The six plates accompanying the section, illustrate wings, antennae and other structures. The mosquitoes represented three species one of which only is definitely determined and this is described as new. The third section reporting upon other Diptera collected, comprises pages 34 to 90, (10 plates). The number of species listed is ninety-three.

representing fifty-five genera. Thirty-two new species are described and one new variety. The plates show various structural characters.

Part D: MALLOPHAGA, 12 pp., by A. W. Baker; ANOPLURA, by G. F. Ferris and G. H. F. Nuttall. Sixteen species are recognized in the former paper. One plate illustrates four species. In the latter contribution three species are listed.

Part E: COLEOPTERA, 27 pp. Forest Insects, including Ipidae, Cerambycidae and Buprestidae, by J. M. Swaine; Carabidae and Silphidae, by H. C. Fall; Coccinellidae, Elateridae, Chrysomelidae and Rhynchophora (excluding Ipidae), by C. W. Leng; Dytiscidae, by J. D. Sherman, Jr. In this part sixty species are determined, four of which are described as new. Three plates showing ipid beetles and their work, illustrate Dr. Swaine's section.

Part F: HEMIPTERA, 5 pp., by Edward P. Van Duzee. Six species are definitely recognized, one of which is described as new. Generic determinations of five other species are given.

Part G: HYMENOPTERA and PLANT GALLS, 38 pp. Sawflies—Tenthredinoidea, by Alex. D. MacGillivray; Parasitic Hymenoptera, Chas. T. Brues; Wasps and Bees, F. W. L. Sladen; Plant Galls, E. P. Felt. In this part, records of thirty-five species are included: others have been determined generically. Of the thirty-five species, twenty-one, mostly sawflies, are described as new. Two plates illustrate the eighth ventral segment in the males of four species of *Bombus*.

Part H: SPIDERS, by J. H. Emerton; ACARINA, by N. Banks; CHILOPODA, by Ralph V. Chamberlin; 22 pp. Twelve species of spiders are recorded, three of which are described as new. Two plates show structural characters. The Acarina collected include seventeen species, all but one previously known. Only two species of Chilopods were represented in the material secured by the expedition. A new species of *Ethpolys* from Washington and Oregon States, as well as a sub-species of this new species, the former from Alaska, are also described by Mr. Chamberlin.

Part I: LEPIDOPTERA, by Arthur Gibson, 58 pp., 6 plates. In this report is also included notes on other species collected in Arctic America, not met with by members of the expedition, all of which material is in the National Collection of Insects at Ottawa. Altogether notes and records of ninety-seven species are included, nine of which are described as new species. In addition, two new varieties are recognized. Plate i shows genitalia of species of Oeneis; ii, undersides of nine examples and underside of one, of species of the same genus. Plates iii, iv and v, the latter two coloured, illustrate a number of the rarer and new species collected by the expedition, of the genera *Pieris, Erebia, Brenthis, Eurymus, Oeneis*, etc.

EMERTON, J. H. Catalogue of the Spiders of Canada, known to the year 1919. Trans. Royal Canadian Institute, Toronto, 1919. This catalogue which contains the names of 342 species of spiders which have been found in Canada will be of considerable interest and value to those persons who are collecting these creatures in Canada.

FALL, H.C. The North American Species of Coelambus. Published by John D. Sherman, Jr., 1919. This pamphlet of 20 pp. includes several Canadian records. Twelve new species are described, three of which are from Western Canada.

HART, CHARLES ARTHUR. The Pentatomoidea of Illinois with keys to the Nearctic Genera. Division of Natural History Survey, Vol. XIII, Article VII, pp. 157-223. This contribution will undoubtedly be of value to our students of Hemiptera. Keys to families, sub-families, tribes, genera and species are given, Notes and distribution records are included of each species. Five plates illustrate structural differences, and one plate shows typical Pentatomoidea.

Lochhead, Wm. Class Book of Economic Entomology, with special reference to the economic insects of the Northern United States and Canada. Philadelphia: P. Blakeston's Son & Co., 436 pp., 257 illustrations, price $2.50. This volume is a companion to Reese's book on Economic Zoology. It is divided into four parts: Part I discusses the structure, growth and economics of insects; Part II the identification of insects injurious to farm, garden and orchard crops, etc.; Part III the classification and description of common insects; Part IV the control of injurious insects. This new volume will certainly find a useful place among economic workers.

Washburn, F. L. Injurious Insects and Useful Birds. J. B. Lippincott Company, Philadelphia; 414 illustrations in text and four coloured plates. A useful work of reference, the result of 21 years of work in entomology on the part of the author. Chapters I to VI deal with the losses to agriculture due to insects and rodents, etc.; Chapters VII to XVIII discuss insects affecting the various crops; chapter XIX, "Our Insect Friends"; XX, "The Relation of Birds to Agriculture" and XXI, "Some Four-footed Pests of the Farm," completes the volume.

NOTES OF CAPTURES.

Species preceded by an asterisk (*) described during 1919.

Lepidoptera.

(Arranged according to Barnes and McDunnough's Check List of the Lepidoptera of North America).

Pieridæ.

33. *Pieris occidentalis* calyce Edw. Edmonton, Alta.: Pocahontas, Alta.; April (K. Bowman). Addition to the Alberta list.

57. *Eurymus hecla glacialis* McLach. Nordegg, Alta.; June. (K. Bowman). Addition to the Alberta list.

59. *Eurymus eriphyle autumnalis* Ckll. Edmonton, Alta.; Banff, Alta.; Nordegg, Alta.; Red Deer, Alta.; (K. Bowman). Addition to Alberta list.

61. *Eurymus christina pallida* Ckll. Nordegg, Alta.; Red Deer, Alta.; (K. Bowman). Addition to Alberta list.

64. *Eurymus christina gigantea* Stkr. Edmonton, Alta.; Nordegg, Alta.; Red Deer, Alta.; (K. Bowman). Addition to Alberta list.

Satyridæ.

* *Oeneis semidea arctica* Gibson. Bernard Harbour, N.W.T., July, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18; Vol. III, Part I, Lepidoptera, p. 13.

* *Oeneis simulans* Gibson. Bernard Harbour, N.W.T., July, 1915, (F. Johansen); Rep. Can. Arctic Exp. 1913-18; Vol. III, Part I, Lepidoptera, p. 14.

* *Oeneis cairnesi* Gibson. White River District, Y.T., lat. 61° 55′, long. 141°, July 16, 1913, (D. D. Cairnes); Rep. Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 15.

* *Oeneis brucei yukonensis* Gibson. Klutlan Glacier, Y.T., June 13-15, 1913, (E. W. Nesham); elevations 8,200-8,500 feet; Rep. Can. Arctic Exp. 1913-18, Vol. III, part I, Lepidoptera, p. 15.

Nymphalidæ.

151. *Euptoieta claudia* Cram. Fort Steele, B.C., (W. B. Anderson). First record we have for British Columbia.

157. *Argynnis leto* Behr. Blairmore, Alta., July, (K. Bowman). Addition to Alberta list.

* *Brenthis natazhati* Gibson. 141st Meridian, north of Mount Natazhat, 8,600 feet, June 15, 1913, (E. W. Nesham); Bernard Harbour. N.W.T., July 14, 1916, (F. Johansen); Rep. Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 21.

* *Brenthis distincta* Gibson. Harrington Creek, Y.T., lat. 65° 05'. July 30, 1912, (D. D. Cairnes); Eduni Mt., 6,000 ft., Gravel River, N.W.T., July 8, 1908, (J. Keele); Tindir Creek, Yukon Territory, lat. 65° 20' international boundary; July 25, 1912, (D. D. Cairnes); Rep. Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 25.

211. *Euphydryas nubigena beani* Skin. Pocahontas, Alta., July, (K. Bowman). Addition to Alberta list.

283. *Vanessa virginiensis* Dru. Edmonton, Alta., July, (D. Mackie). Addition to Alberta list.

Lycaenidæ.

352. *Strymon melinus* Hbn. Onah, Man., Aug. 20, 1914, (E. Criddle).

* *Plebeius incariodes blackmorei* B. & McD. Goldstream, V. I., B.C., May 31, (E. H. Blackmore); Can. Ent. LI, 92.

427. *Plebeius melissa* Edw. In the note regarding this species published in the *Ent. Record* for 1918, the word "common" should be corrected to read "uncommon."

Sphingidæ.

753. *Proserpinus flavofasciata* Wlk. Mile 214, H. B. Ry., Man., July 17, (J. B. Wallis).

Saturniidæ.

794. *Pseudohazis eglanterina* Bdv. Blairmore, Alta., (K. Bowman). Addition to Alberta list.

Arctiidæ.

851. *Roeselia minuscula* Zell. Miami Man., July 4, 1914, (J. B. Wallis).

Noctuidæ.

1076 *Melaporphyria immortua* Grt. Edmonton, Alta., May, (K. Bowman). Addition to Alberta list.

* *Parabarrovia keelei* Gibson. Mountain below Twitza River, near Gravel River, N.W.T., July 2, 1908, (J. Keele); Rep Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 33.

1275 *Euxoa infracta* Morr. Blairmore, Alta., Aug., (K. Bowman). Addition to Alberta list.

1332. *Euxoa esta* Sm. Wellington, B.C., Aug., 19, 1903, (T. Bryant); Victoria, B.C., Sept. 3, 1916, (E. H. Blackmore). Listed in 1906 B.C. list under the name *velleripennis*, (E.H.B.).

1339. *Euxoa campestris* Grt. Edmonton, Alta., August, (D. Mackie). Addition to Alberta list.

1379. *Chorizagrotis thanatologia perfida* Dod. Peachland, B.C., July 30, 1919, (J. B. Wallis).

1455. *Agrotis cinereicollis* Grt. Lillooet, B.C., July 3, 1918, (A. W. A. Phair). Peachland, B.C., Aug. 8, 1915, (J. B. Wallis). New to British Columbia, (J. B. Wallis).

1507. *Aplectoides occidens* Hamps. Sicamous, B.C., Aug. 12, 1915, (J. B. Wallis).

1596. *Rhynchagrotis gilvipennis* Grt. Maillardville, B.C., July 18, 1919, (L. E. Marmont).

* *Anarta subfumosa* Gibson. Armstrong Point, Victoria Island, N.W.T., July, 1916, (J. Hadley); Rep. Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 34.

1871. *Stretchia plusiæformis* Hy. Edw. Among some specimens determined for Canon V. A. Huard, of Quebec, Que., was one of this species, which was described from Nevada. As I had never seen this species from Eastern Canada, I questioned its occurrence in Quebec Province, but Canon Huard assured me that it was captured at Chicoutimi in 1881. (A.G.).

1900. *Perigrapha algula* Sm. Sahtlam, Van. Isl., B.C., May 10, 1918, (G. O. Day).

1986. *Rancora brucei* Sm. Nordegg, Alta., June, (K. Bowman). Addition to Alberta list.

2060. *Oncocnemis umbrifascia* Sm. Lillooet, B.C., Sept. 5, 1918, (A. W. A. Phair). New to British Columbia, (E.H.B).

2137. *Graptolitha ferrealis* Grt. Edmonton, Alta., April (D. Mackie). Addition to Alberta list.

2174. *Xylena thoracica* Put.-Cram. Okanagan Falls, B.C., April 7, 1913, (E. M. Anderson); Rossland, B.C., (W. H. Danby). New to British Columbia. It may be mentioned here that the species going under the name of *cineritia* Grt., in B.C. collections is in reality *mertena* Sm., (E.H.B.).

2178. *Eurotype confragosa* Morr. Tahu River, B.C., Sept. 30, 1906, (T. Bryant). This is the first authentic record for B.C. *Medialis* Grt., which is a synonym of *confragosa* Morr. is recorded from Wellington, B.C., in the 1906 check list but upon a recent examination of the specimen I find it to be *E. contadina* Sm. (E.H.B.).

* *Homoglaea murrayi* Gibson. Bernard Harbour, N.W.T., July 10, 1916. (F. Johansen); Rep. Can. Arctic Exp. 1913-18, Vol. III, Part I, Lepidoptera, p. 36.

2316. *Trachea mixta* Grt. Winnipeg, Man., June 24, 1911, (J. B. Wallis).

2380. *Luperina passer conspicua* Morr. Edmonton, Alta., (D. Mackie). Addition to Alberta list.

2513. *Meroloncha ursina* Sm. Nordegg, Alta., June, (K. Bowman). Addition to Alberta list. Wellington, B.C., June 6, 1904, (T. Bryant). This name is new to B.C., but I suspect it is the same insect which has been previously recorded under the name *lupini* Grt. Very rare in B.C. collections, (E.H.B).

2636. *Helotropha reniformis atra* Grt. Victoria, B.C., Aug. 2, 1916, (E. H. Blackmore); Duncan, B.C., (E. M. Skinner). First record of the form *atra* from B.C., (E.H.B.).

2837. *Eutricopis nexilis* Morr. Reared from larvæ found on *Antennaria* at Aylmer, Que., emerged in office Jan. 10, 1920, (J. McDunnough).

3012. *Sarrothripus revayana cinereana* N. & D. Vancouver, B. C., May 6, 1902; Mission, B.C., Aug. 8, 1904, (R. V. Harvey). New record for B.C., (E.H.B.).

* *Autographa rectangula nargenta* Ottol. Vancouver Island, (A. W. Hanham); Kalso, B.C., (J. W. Cockle); Jour. N. Y. Ent. Soc., XXVII, 122.

* *Autographa interalia* Ottol. Nordegg, Alta., (K. Bowman); Banff, Alta., (R. Ottolengui); Jour. N. Y. Ent. Soc., XXVII, 122.

* *Autographa diversigna* Ottol. Nordegg, Alta., (K. Bowman); Laggan, Alta., (T. Bean); Jour. N.Y. Ent. Soc. XXVII, 121.

* *Autographa magnifica* Ottol. Ucluelet, B.C., (C. H. Young); Jour. N.Y. Ent. Soc. XXVII, 124.

3241. *Autographa ottolenguii* Dyar. Dawson, Y.T., 1909, (A. Day).

Autographa pulchrina Haw. Dawson, Y.T., 1909, (A. Day). This record was received from Mr. G. O. Day, of Duncan, B.C., with the statement "Dr. Ottolengui gave me to understand that this is the first record for the North American Continent."

3313. *Melipotis versabilis* Harv. Quamichan, Van. Isl., B.C., May 31, 1908, (G. O. Day); Cawston, B.C., July 24, 1917, (W. R. S. Metcalfe).

3333. *Syneda alleni saxea* Hy. Edw. Blairmore, Alta., June, (K. Bowman). Addition to Alberta list.

3487. *Epizeuxis scobialis* Grt. Kingsmere, Que., July 23, 1919, (R. N. Chrystal).

3501. *Zanclognatha minoralis* Sm. Quebec, Que., July 27, 1918, (V. A. Huard). Addition to Quebec list.

Notodontidæ.

3640. *Heterocampa umbrata* Wlk. Aylmer, Que., June 2, 1919, (C. B. Hutchings). Addition to Quebec list.

Lymantriidæ.

* *Olene dorsipennata* B. & McD. Chelsea, Que., July 8-14: Aylmer, Que., (J. McDunnough); Can. Ent. LI, 102.

3712. *Olene vagans willingi* B. & McD. Edmonton, Alta., July, (D. Mackie). Addition to Alberta list.

3712. *Olene vagans grisea* B. & McD. Quamichan, Vancouver Island, B.C., July 22, 1916, (G. O. Day).

Geometridæ.

3972. *Coryphista meadi* Pack. Blairmore, Alta., June-July, (K. Bowman). Addition to Alberta list.

3990. *Thera otisi* Dyar. Mt. Arrowsmith, Vancouver Island, B.C., (T. Bryant).

3999. *Dysstroma cervinifascia* Wlk. Nordegg, Alta., July, (K. Bowman). Addition to Alberta list.

4017. *Hydriomena renunciata* Wlk. "Province of Quebec" (V. A. Huard). Addition to Quebec list. Edmonton, Alta., May-June, (K. Bowman). Addition to Alberta list.

4208. *Eupithecia albicapitata* Pack. Edmonton, Alta., July, (K. Bowman). Addition to Alberta list.

* *Eupithecia probata* S. & C. Duncan, B.C., (C. Livingstone); Victoria, B.C., March 30, 1916; April 3, 1916, (E. H. Blackmore); Lepidopterist iii, 105.

* *Eupithecia moirata* S. & C. Penticton, B.C., April, 1913, (E. H. Blackmore); Lepidopterist, iii, 107.

4325. *Drepanulatrix liberaria* Wlk. Aylmer, Que., Sept. 3, 1919, (C. B. Hutchings).

4332. *Philobia ulsterata* Pears. Edmonton, Alta., June, (K. Bowman). Addition to Alberta list.
4349. *Macaria purcellata* Tayl. Nordegg, Alta., July, (K. Bowman). Addition to Alberta list.
4465. *Caripeta divisata* Wlk. Edmonton, Alta., July, (K. Bowman). Addition to Alberta list.
4489. *Pygmæna simplex* Dyar. Nordegg, Alta., July, (K. Bowman). Addition to Alberta list.

Pyralidæ.

4974. *Diaphania nitidalis* Stoll. Meach Lake, Que., Sept. 16, 1903, (C. H. Young). Addition to Quebec list.
5032. *Loxostege commixtalis* Wlk. Banff, Alta.; Nordegg, Alta., June-July, (K. Bowman). Addition to Alberta list.
* *Diasemia alaskalis* Gibson. Collinson Point, Alaska, July 10, 1914, (F. Johansen); W. of Konganevik (Camden Bay) Alaska, July, 1914, (F. Johansen); Rep. Can. Arctic Exp., Vol. III, Part I, Lepidoptera, p. 45.
5051. *Diasemia plumbosignalis* Fern. Nordegg, Alta., July, (K. Bowman). Addition to Alberta list.
5088. *Phlyctænia ferrugalis* Hbn. Edmonton, Alta., June, (K. Bowman). Addition to Alberta list.
* *Pyrausta ainsliei* Heinrich. St. John's, Que., (W. Chagnon). Jour. Agr. Research, XVIII, 3, 175.
5135. *Pyrausta fumoferalis* Hlst. Edmonton, Alta., June, (K. Bowman). Addition to Alberta list.
5548. *Mineola tricolorella* Grt. Reared from larvæ found in apples in Okanagan Valley, B.C., (E. P. Venables).
* *Pyla arctiella* Gibson. Collinson Point, Alaska, July 17, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part I, Lepidoptera, p. 46.

Pterophoridæ.

5915. *Pterophorus sulphureodactylus* Pack. Pointe Aux Alouelles, Ste. Catherine Bay, opp. Tadousac, Que., July 28, 1919, (V. A. Huard). Addition to Quebec list.

Gelechiidæ.

* *Aristotelia fragariæ* Busck. Victoria, B.C., (W. Downes); Proc. Ent. Soc. of Wash., XXI, 52.
6166. *Paralechia pinifoliella* Cham. Ottawa, Ont., July 1, 1907, (C. H. Young).
6200. *Anacampsis tristrigella* Wlshm. Aylmer, Que., June 21, 1919, (J. McDunnough). Addition to Quebec list.
6283. *Gelechia conclusella* Wlk. Ottawa, Ont., June 24, 1906, (C. H. Young).
6288. *Gelechia panella* Busck. Maple Bay, B.C., Aug. 3, 1914, (A. W. Hanham).
6290. *Gelechia fuscotæniaella* Cham. Aweme, Man., Sept. 5, 1915, (N. Criddle).

Tortricidæ.

* *Tortricodes fragariana* Busck. Victoria, B.C., (W. Downes); Proc. Ent. Soc., Wash., XXI, 52.

Gracilariidæ.

7925. *Lithocolletis affinis* F. & B. Aylmer, Que., July 24, 1919; mines in *Lonicera*, (J. McDunnough).

Coleoptera.

(Arranged according to Henshaw's list of Coleoptera of America, North of Mexico.)

Carabidæ.

* *Bembidium lengi* Notman. Cochrane, Ont., Aug., 1918, (Howard Notman); Jour. N.Y. Ent. Soc., XXVII. 98.

* *Pterostichus laevilatus* Notman. Golden, B.C., (Leng. col.): Jour. N.Y. Ent. Soc., XXVII, 231.

680. *Celia gibba* Lec. Aweme, Man., March 29, 1918; Maryfield, Sask., Aug. 30, 1916, (N. Criddle).

Celia brumalis Casey. Aweme, Man., Sept. 2, 1916, (E. Criddle). New to Canada.

* *Asaphidion yukonense* Wickham. Yukon Crossing, Y.T., May 21, 1911, (J. M. Jessup); Proc. Ent. Soc., Wash., XXI, 180.

Dytiscidæ.

1292. *Coelambus suturalis* Lec. Winnipeg, Man., Thornhill, Man., Miami, Man., Mile 214 to 332, H.B.R., Man., (J. B. Wallis). New to Manitoba.

* *Coelambus canadensis* Fall. Winnipeg, Man., Stony Mountain, Man., Miami, Man., (J. B. Wallis); N. A. species of *Coelambus*, published by J. D. Sherman, New York, 1919.

* *Coelambus tumidiventris* Fall. Stony Mountain, Man., April 15, 1912; Winnipeg, Man.; Stonewall, Man., (J. B. Wallis); Edmonton, Alta., April 8, 1916, (F. S. Carr); N.A. species of *Coelambus*, published by J. D. Sherman, New York, 1919.

* *Coelambus hudsonicus* Fall. Ungava Bay, H.B.T., (L. M. Turner); N.A. species of Coelambus published by J. D. Sherman, New York, 1919.

Coelambus punctilineatus Fall. Stony Mountain, Man., April 13, 1912, (J. B. Wallis).

1441. *Agabus lecontei* Cr. Peachland, B.C., Aug. 7, 1919, (W. R. Metcalfe and J. B. Wallis).

Silphidæ.

* *Colon elongatum* Notman. Cochrane, Ont., Aug., 1918, (Howard Notman); Jour. N.Y. Ent. Soc., XXVII, 98.

Pselaphidæ.

1899. *Batrisus fontalis* Lec. Aweme, Man., April 18, 1919; in swarm of ants, (*Acanthomyops*), (S. Criddle).

Staphylinidæ.

Atheta (Acrostoma) blanchardi Ful. Stonewall, Man., July 18, 1918, in rotten fungus, (J. B. Wallis).

Atheta comitata Csy. Stonewall, Man., Aug. 18, 1918, in fungus. (J. B. Wallis). New to Manitoba.

Atheta (Datomicra) celata Er. Onah, Man., July 13, 1918; in larch swamp, (J. B. Wallis). New to Manitoba.

Atheta (Demetrota) subrugosa Kiew. Onah, Man., July 12, 1918, in moss, (J. B. Wallis). New to Manitoba.

Aleochara (Polychara) deflecta Say. Stonewall, Man., Aug. 18, 1918, (J. B. Wallis). New to Manitoba.

Aleochara (*Euryodma*) *pleuralis* Csy. Treesbank, Man., July 18, 1918. (J. B. Wallis). New to Manitoba.

Silusa modica Csy. Stonewall, Man., in rotten fungus, (J. B. Wallis). New to Manitoba.

Anomognathus cuspidata Er. Winnipeg, Man., Aug. 27, 1918; under bark of rotten *Negundo,* (J. B. Wallis). New to Manitoba. Apparently introduced from Europe, (A.F.).

Homalota plana Gyll. Winnipeg, Man., July 30-Aug. 14, 1918; under bark of rotten *Negundo,* (J. B. Wallis). New to Manitoba. Apparently introduced from Europe, (A.F.).

Gnypeta manitobæ Csy. Stonewall, Man., Aug. 18, 1918, (J. B. Wallis).

Gyrophaena nana Payk. Winnipeg, Man., Aug. 27, 1918, in fungus, (J. B. Wallis). New to Manitoba.

Gyrophaena pulchella Heer. Stonewall, Man., Aug. 18, 1918; Winnipeg, Man., Aug. 27, 1918; in fresh whitish fungi, among the gills. (J. B. Wallis). Apparently an introduction from Europe, (A.F.). New to Manitoba.

* *Lathrobium tenebrosum* Notman. Cochrane, Ont., Aug., 1918, (Howard Notman); Jour. N.Y. Ent. Soc., XXVII, 99.

* *Lathrobium humile* Notman. Cochrane, Ont., Aug., 1918, (Howard Notman); Jour. N.Y. Ent. Soc., XXVII, 100.

* *Scopæus linearis* Notman. Cochrane, Ont., Aug., 1918, (Howard Notman); Jour. N.Y. Ent. Soc., XXVII, 100.

Endomychidæ.

3180. *Phymaphora californica* Horn. Duncan, B.C., (A. W. Hanham).

Erotylidæ.

3239. *Tritoma flavicollis* Lec. Duncan, B.C., (A. W. Hanham).

Colydiidæ.

3271. *Lasconotus pusillus* Lec. Aweme, Man., Onah, Man., July, 1919. (N. Criddle).

Histeridæ.

* *Saprinus rugosifrons* Fall. Aweme, Man., (N. Criddle); Can. Ent., LI, 213.

* *Saprinus castanipennis* Fall. Aweme, Man., June 21, 1918, (N. Criddle); Can. Ent., LI, 214.

* *Saprinus iris* Fall. Aweme, Man., May 31, 1909, July 1, 1915, (N. Criddle); Can. Ent., LI, 214.

Nitidulidæ.

3713. *Epuræa aestiva* Linn. Aweme, Man., 1919, (N. Criddle).

* *Epuræa ornatula* Notman. Cochrane, Ont., Aug., 1918, (H. Notman); Jour. N.Y. Ent. Soc., XXVII, 102.

Dascyllidæ.

3991. *Eucinetus punctulatus* Lec. Stonewall, Man., Aug. 18, 1918; in rotten fungus, (J. B. Wallis).

Elateridæ.

4390. *Anthous cucullatus* Say. Husavick, Man., July 27, 1912, (J. B. Wallis). New to Manitoba.

4403. *Anthous vittiger* Lec. Winnipeg, Man., (J. B. Wallis). New to Manitoba.

Ptinidæ.

Ptilinus lobatus Csy. Aweme, Man., June 24, 1919, (N. Criddle); Husavick, Man., July 6, 1917, (L. H. D. Roberts). New to Manitoba.

5359. *Dinoderus substriatus* Payk. Mile 214, H.B.R., Man., Winnipeg, Man., June, July; Peachland, B.C., (J. B. Wallis).

Cisidæ.

* *Dolichocis manitoba* Dury. Aweme, Man., Oct., 1918, (N. and T. Criddle); Can. Ent., LI, 158.

* *Cis criddlei* Dury. Aweme, Man., Oct., 1915-1918, (E. and N. Criddle); Can. Ent., LI, 158.

Scarabæidæ.

5426. *Canthon ebenus* Say. Lyleton, Man., Aug. 27, 1919; Boissevain, Man., (N. Criddle).

5551. *Aphodius haldemani* Horn. Rosebank, Man., Aug. 10, 1917, (J. B. Wallis). New to Manitoba.

* *Serica cucullata* Dawson. Montreal, Que., May 6, 1905, (A. F. Winn); Ottawa, Ont.; Winnipeg, Man., (J. B. Wallis); Aweme, Man., (N. Criddle); Kentville, N.S.; British Columbia; Jour. N.Y. Ent. Soc., XXVII, 34.

Cerambycidæ.

* *Callidium subopacum* Sw. South of Rampart House, Y.T., (D. H. Nelles); Rep. Can. Arctic Exp., 1913-1918, Part E, Coleoptera, p. 12.

6250. *Pachyta rugipennis* Newm. Winnipeg, Man., May 18, 1919, (L. H. D. Roberts). New to Manitoba.

6385. *Monohammus minor* Lec. Winnipeg, Man., July 15, 1918, (J. B. Wallis). New to Manitoba.

Chrysomelidæ.

6558. *Syneta carinata* Mann. Mt. Prevost, near Duncan, B.C., 2,500 feet, (A. W. Hanham).

6721. *Xanthonia villosula* Melsh. Bird's Hill, Man., Sept. 23, 1917, (J. B. Wallis). New to Manitoba.

10407. *Monoxia debilis* Lec. Melita, Man., July 1, 1919; collected on *Grindelia squarrosa*, (N. Criddle).

7001a. *Systena ligata* Lec. Husavick, Man., Aug. 3, 1914, on Canada thistle; Winnipeg, Man., Aug. 14, 1918, (J. B. Wallis). New to Manitoba.

Tenebrionidæ.

7528. *Scaphidema aenolum* Lec. Stonewall, Man., Aug. 7, 1918; under bark of dead aspen, (J. B. Wallis).

Melandryidæ.

7656. *Phryganophilus collaris* Lec. Duncan, B.C., (A. W. Hanham).

7695. *Canifa pallipes* Melsh. Winnipeg, Man., May 28, 1911; Victoria Beach, Man., July 1, 1918; Miami, Man., June 27, 1916; Aweme, Man., July 15, 1918, (J. B. Wallis).

Œdemeridæ.

7733. *Nacerdes melanura* Linn. Vancouver, B.C., July 15, 1919, (A. W. Hanham).

Meloidæ.

8025. *Nemognatha apicalis* Lec. Lillooet, B.C., July 13, (A. W. Hanham).

Curculionidæ.

* *Trichalophus stefanssoni* Leng. Bernard Harbour, N.W.T., Sept. 26, 1914; May 22, July 6, 7, 1915; June, July and Sept., 1916, (F. Johansen); Cape Krusenstern, N.W.T., July, 1916, (D. Jenness); Kogluktualuk river, Coronation Gulf, N.W.T., July, 1915, (J. J. O'Neill); Langton Bay, N.W.T., 1911, (V. Stefansson); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part E, Coleoptera, p. 20.

8381. *Apion pennsylvanicum* Boh. Magnus, Man., Sept. 2, 1917, (J. B. Wallis).

Apion commodum Fall. Stony Mountain, Man., Aug. 8, 1918, on ***Psoralea esculenta,*** (J. B. Wallis).

Apion finitimum Fall. Magnus, Man., Sept. 2, 1917, (J. B. Wallis).

Apion nasutum Fall. Onah, Man., July 12, 1918, (J. B. Wallis). New to Canada.

10823. *Macrops ulkei* Dietz. Aweme, Man., May 7, 1919, (N. Criddle).

8576. *Tanysphyrus lemnæ* Fab. Miami, Man., June 27, 1916; Treesbank, Man., July 18, 1918, (J. B. Wallis). New to Manitoba.

8619. *Magdalis subtincta* Lec. St. Norbert, Man., June 24, 1917; Aweme, Man., July 15, 1918, (J. B. Wallis).

8620. *Magdalis hispoides* Lec. Onah, Man., July 8-12, 1918, (J. B. Wallis). New to Manitoba.

8627. *Magdalis alutacea* Lec. Victoria Beach, Man., July 1, 1918, (J. B. Wallis). New to Canada.

10958. *Promecotarsus densus* Csy. Aweme, Man., July 15, 1918, (J. B. Wallis). New to Manitoba.

8669. *Anthonomus canus* Lec. Onah, Man., July 13, 1918, (J. B. Wallis). New to Manitoba.

Ceutorhynchus solitarius Fall. St. Norbert, Man., June 24, 1917, (J. B. Wallis). New to Manitoba.

Calandridæ.

Sphenophorus aequalis. Stonewall, Man., July 5, 1918, (J. B. Wallis). New to Manitoba.

Ipidæ.

* *Dendroctonus johanseni* Sw. Sandstone rapids, Coppermine river, N.W.T., Feb., 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part E, Coleoptera, p. 5.

* *Carphoborus andersoni* Sw. Sandstone rapids, Coppermine river, N.W.T., Feb. 15, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part E, Coleoptera, p. 6.

DIPTERA.

(Arranged according to a catalogue of North American Diptera, by J. M. Aldrich, Smithsonian Misc. Coll. XLVI, No. 1,444. The numbers refer to the pages in the catalogue.)

Tipulidæ.

* *Dicranomyia alascaensis* Alex. Nome, Alaska, Aug. 24, 25, 1916. (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 5.

80. *Limnobia sciophila* O.S. Lillooet, B.C., June 21, 1917, (M. H. Ruhmann); Gordon Head, B.C., April 30, 1918, (W. Downes).

81. *Limnobia solitaria* O.S. Lillooet, B.C., June 25, 1919, (M. H. Ruhmann).

97. *Xiphura topazina* O.S. Vineland, Ont., May 5, 1915, (W. A. Ross).

* *Nephrotoma arcticola* Alex. Bernard Harbour, N.W.T., July 1-14, 1916; July-Aug., 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 10.

98. *Nephrotoma ferruginea* Fab. Bowmanville, Ont., June, 1913, (W. A. Ross).

* *Nephrotoma euceroides* Alex. Perth, N.B., June 15, 1915, (F. M. McKenzie); Can. Ent., LI, 172.

* *Erioptera angustipennis* Alex. Bernard Harbour, Dolphin and Union Strait, N.W.T., Aug. 1-7, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 5.

* *Tipula nebulipennis* Alex. Battle Harbour, Labrador, Aug. 1, 1912, (G. P. Engelhardt); Can. Ent., LI, 170.

* *Tipula trypetophora* Dietz. Victoria, B.C., July 6, 1912; An. Ent. Soc. Amer., XII, 89.

* *Tipula johanseni* Alex. Bernard Harbour, N.W.T., July 10, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 11.

* *Tipula diflava* Alex. Bernard Harbour, N.W.T., July 12, 1915; Herschel Island, Y.T., July, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 12.

* *Tipula hewitti* Alex. Bernard Harbour, N.W.T., July 1-14, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 14.

* *Tipula subpolaris* Alex. Bernard Harbour, N.W.T., July-Aug., (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 14.

* *Tipula besselsoides* Alex. Bernard Harbour, N.W.T., July 1-14, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 15.

* *Tipula subarctica* Alex. W. of Kongenevik, Camden bay, Alaska, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., Part C, Diptera, p. 15.

* *Tricyphona frigida* Alex. Ketchikan, Alaska, Sept. 10, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 7.

* *Tricyphona brevifurcata* Alex. W. of Konganevik, Camden bay, Alaska, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 6.

* *Limnophila rhicnoptiloides* Alex. Bernard Harbour, N.W.T., July 15, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 6.

* *Stygeropis parrioides* Alex. W. of Konganevik, Camden bay, Alaska, June 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 9.

100. *Tipula angustnpennis* Loew. Vernon, B.C., April 2, 1915, (M. H. Ruhmann).

101. *Tipula cognata* Doane. Vernon, B.C., April 2, 1915, (M. H. Ruhmann).

102. *Tipula dorsolineata* Doane. Vernon, B.C., (M. H. Ruhmann); Victoria, B.C., (W. Downes).

102. *Tipula eluta* Loew. Vineland, Ont., Aug. 18, 1914, (W. A. Ross).

* *Tipula noveboracensis* Alex. Beaver Dam, N.B., June 23, 1914, (J. D. Tothill); Can. Ent., LI, 167.

Chironomidæ.

* *Tanypus alaskensis* Mall.; Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 35.

* *Diamesa arctica* Mall. Colville Mts., Wollaston peninsula, Victoria Island, July 22-29, 1915, (D. Jenness). Angmaloktok, Colville mountains, Wollaston peninsula, Victoria Island, July 29, 1915, (D. Jenness); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 37.

Culicidæ.

* *Ædes pionips* Dyar. White River, Ont., June 17-25, 1918; Prince Albert, Sask., Aug. 14-18, 1918; Red Deer, Alta., July 30-Aug. 3, 1918; Nepigon, Ont., June 26, 1918; Lochearn, Alta, Aug. 5-7, 1918; Lamoral, Alta., Aug. 6, 1918; Lake Louise, Alta., July 11-17, 1918, (H. G. Dyar); White River, Ont., June 24, 1907, (Knab); Kenogami river, Ont., June 30, 1903, (W. J. Wilson); Insecutor Inscitiæ Menstruus, VII, 19.

* *Ædes intrudens* Dyar. White River, Ont., June 12-25, 1918; Nepigon, Ont., June 26, 1918; Dryden, Ont., June 29-30, 1918; Winnipeg Beach, Man., July, 1918; Lake Minnewanka, Alta, July 22, 1918; Banff, Alta., July 7-25, 1918; Laggan, Alta, July 11, 1918, (H. G. Dyar). With the description the following statement appears: "Eastern records are found in the monograph under *impiger* (page 757). They are correct, except that 'Ottawa, Ontario (J. Fletcher)' should be transferred to *lazarensis*;" Insecutor Inscitiæ Menstruus, VII, 24.

* *Ædes nearcticus* Dyar. Bernard Harbour, N.W.T., July 9, 1915; June 21-July 1, 1916, (F. Johansen); Collinson Point, Alaska, June 23, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Part C, Diptera, p. 32.

Bibionidæ.

166. *Bibio nervosus* Loew. Vernon, B.C., (M. H. Ruhmann); Saanich, B.C., (W. Downes).

Simuliidæ.

* *Simulium similis* Mall. Hood river, Arctic sound, N.W.T., Aug. 28, 1915, (R. M. Anderson); Bathurst inlet, N.W.T., Sept 1, 1915, (R. M. Anderson); Rep. Can. Arctic Exp., 1913-18; Vol. III, Part C, Diptera, p. 42.

* *Prosimulium borealis* Mall. Wollaston peninsula, Victoria island, 1915, (D. Jenness); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 41.

Stratiomyidæ.

179. *Sargus decorus* Say. Lillooet, B.C., June 20, 1917, (M. H. Ruhmann).
180. *Sargus viridis* Say. Kelowna, B.C., June 18, 1918, (R. C. Treherne).
182. *Stratiomyia discalis* Loew. Vernon, B.C., May 17, 1917, (M. H. Ruhmann).
183. *Stratiomyia norma* Wied. Kelowna, B.C., June 26, 1918, (R. C. Treherne).
183. *Stratiomyia meigenii* Wied. Vernon, B.C., June 21, 1917, (R. C. Treherne).
183. *Stratiomyia maculosa* Loew. Lillooet, B.C., June 25, 1917, (M. H. Ruhmann).
189. *Nemotelus arator* Mel. Walhachin, B.C., July 11, 1918, (E. R. Buckell).

Tabanidæ.

195. *Chrysops obsoletus* Wied. Vineland, Ont., June 20, 1919, (W. A. Ross).
201. *Tabanus insuetus* O.S. Vernon, B.C., April 15, 1915, (M. H. Ruhmann).

205. *Tabanus maculifer* Bigot. Lillooet, B.C., July 24, 1917, (R. C. Theherne).
206. *Tabanus procyon* O.S. Vernon, B.C., June 8, 1918, (R. C. Treherne).
207. *Tabanus rhombicus* O.S. Vernon, B.C., April 15, 1915, (M. H. Ruhmann).
208. *Tabanus stygius* Say. Vineland, Ont., July 8, 1919, (C. H. Curran).

Bombyliidæ.

231. *Anthrax hypomelas* Macq. Penticton, B.C., (R. C. Treherne); Walhachin, B.C., (E. R. Buckell).
234. *Anthrax sinuosa* Wied. Lillooet, B.C., July 23, 1917, (R. C. Treherne).
236. *Bombylius lancifer* O.S. Lillooet, B.C., Oyama, B.C., (M. H. Ruhmann).
* *Villa webberi* Jhn. Montreal, Que., June 11, (G. Chagnon), Ottawa, Ont., June 14, (Bro. Germain); Psyche, XXVI, 11.
* *Ploas atratula* Loew. Goldstream, B.C., June 2, 1918, (W. Downes).

Therevidæ.

247. *Psilocephala lævigata* Loew. Walhachin, B.C., July 11, 1918, (E. R. Buckell).
248. *Thereva egressa* Coq. Vernon, B.C., June 10, 1918, (R. C. Treherne).

Asilidæ.

256. *Stenopogon californiæ* Wlk. Vernon, B.C., July 8, 1918, (R. C. Treherne).
259. *Cyrtopogon callipedilus* Loew. Vernon, B.C., May 5, 1915, (M. H. Ruhmann).
260. *Cyrtopogon longimanus* Loew. Lillooet, B.C., July 16, 1917, (M. H. Ruhmann.
271. *Laphria pubescens* Will. Duncan, B.C., July 28, 1918, (W. Downes).
* *Erax harveyi* Hine. Vernon, B.C., Aug. 11-15, 1904, (R. V. Harvey); An. Ent. Soc. Amer., XII, 115.

Dolichopodidæ.

* *Medeterus frontalis* Van Duzee. Joliette, Que., July 13, (J. Ouillet); Proc. Cal. Acad. Sci., Aug., 1919, p. 266.
* *Medeterus vittatus* Van. Duzee. Kearney, Ont., July 26: Toronto, Ont., Sept. 2; Niagara Falls, Ont., July 20, (M. C. Van Duzee); Proc. Cal. Acad. Sci., Aug., 1919, p. 268.
* *Hydrophorus pilitarsis* Mall. Teller, Alaska, July 29, 1913; Aug. 6, 1913, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 51.
363. *Dolichopus pachynemus* Loew. Outremont, Que., June 20, (J. Ouillett); Chatham, Ont., June 17, 1915, (M. C. Van Duzee). Addition to Quebec list.
* *Dolichopus dasyops* Mall. Bernard Harbour, N.W.T., July 10, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-18, Vol. III, Part C, Diptera, p. 49.
369. *Pelastoneurus lactus* Loew. St. Louis, Que., Aug. 14, (J. Ouillet). Addition to Quebec list.

Empidæ.

* *Rhamphomyia erinacioides* Mall. W. of Konganevik, Camden bay, Alaska, July 4, 1914, (F. Johansen); Barter island, Arctic coast of Alaska, July 11, 1914, (D. Jenness); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 45.

* *Rhamphomyia ursina* Mall. Bernard Harbour, N.W.T., July 19, 1915, (F. Jonhansen) : Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 46.

* *Rhamphomyia similata* Mall. Bernard Harbour, N.W.T., July 18, 1915, (F. Johansen) : Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 46.

* *Rhamphomyia herschelli* Mall. Herschel island, Y.T., July 29, 1916, (F. Johansen) ; Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 47.

* *Rhamphomyia conservativa* Mall. W. of Bernard Harbour, N.W.T., July 14, 1916; Herschel Is., Y.T., July 29, 1916; Bernard Harbour, N.W.T., July 10, 18, 19, and Aug. 1-7, 1915; Young Point, N.W.T., July 18, 1916, (F. Johansen) ; Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 48.

Lonchopteridæ.

333. *Lonchoptera lutea* Panz. Vernon, B.C., Aug. 31, 1917, (M. H. Ruhmann).

Phoridæ.

* *Aphiochaeta platychira* Mall. Nome, Alaska, Aug. 21, 24, 25, 1916, (F. Johansen) ; Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 52.

* *Aphiochaeta alaskensis* Mall. Nome, Alaska, Aug. 24, 25, 1916, (F. Johansen). Rep. Can. Arctic Exp. 1913-1918, Vol. III, Part C, Diptera, p. 52.

Syrphidæ.

350. *Pipiza fraudulenta* Loew. Vineland, Ont., June 8, 1919, (C. H. Curran).
354. *Myiolepta strigilata* Loew. Vineland, Ont., June 10, 1919, (C. H. Curran).
354. *Myiolepta nigra* Loew. Vineland, Ont., June 16, 1919, (C. H. Curran).
362. *Didea fasciata fuscipes* Loew. Lillooet, B.C., July 24, 1917, (R. C. Treherne) ; Vineland, Ont., June 6, Sept. 20, 1919, (C. H. Curran).
366. *Syrphus genualis* Will. Walhachin, B.C., July 30, 1918, (E. R. Buckell).

Syrphus knabi Shan. Vineland, Ont., Sept. 9, 1919, (C. H. Curran).

* *Syrphus sodalis interruptus* Mall. W. of Kongenevik, Camden Bay, Alaska, July 4, 1914, (F. Johansen) ; Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 55.

368. *Syrphus xanthostoma* Will. Vernon, B.C., May 13, 1917, (M. H. Ruhmann).
370. *Mesogramma boscii* Macq. Saanich, B.C., May 10, 1918, (W. Downes).
371. *Mesogramma geminata* Say. Saanich, B.C., June 10, 1918, (W. Downes).
384. *Eristalis aeneus* Fab. Vineland, Ont., July 3-9, 1919, (C. H. Curran). First record we have for Canada.
387. *Eristalis inornatus* Loew. Vernon, B.C., May 31, 1917, (M. H. Ruhmann).
392. *Helophilus chrysostoma* Wied. Kelowna, B.C., June 26, 1918, (R. C. Treherne).
393. *Helophilus laetus* Loew. Vineland, Ont., June 4, July 7, 1919, (C. H. Curran).
394. *Asemosyrphus mexicanus* Macq. Kelowna, B.C., July 9, 1918, (R. C. Treherne).

Eumerus strigatus Fall. Aweme, Man., May 17, 1919, (N. Criddle) ; Vineland, Ont., June-Sept., (C. H. Curran).

398. *Xylota flavitibia* Bigot. Vernon, B.C., Aug. 10, 1915, (M. H. Ruhmann).
402. *Criorhina analis* Macq. Vineland, Ont., June 10, 1919, (C. H. Curran).
404. *Spilomyia longicornis* Loew. London, Ont., Aug. 25; Vineland, Ont., Sept. 8, 1919, (C. H. Curran).

Conopidæ.

412. *Myopa clausa* Loew. Kelowna, B.C., May 17, 1917, (M. H. Ruhmann).
413. *Myopia vicaria* Walk. Nelson, B.C., April 29, 1918, (R. C. Treherne).

Oestridæ.

419. *Cuterebra tenebrosa* Coq. Vernon, B.C., July, 1916, (M. H. Ruhmann).

Tachinidæ.

423. *Phorantha occidentis* Walk. Walhachin, B.C., July 16, 1918, (E. R. Buckell).
447. *Senotainia rubriventris* Macq. Vernon, B.C., (M. H. Ruhmann); Walhachin, B.C., July, (E. R. Buckell).
448. *Senotainia trilineata* Van der Wulp. Walhachin, B.C., July, (E. R. Buckell); Vernon, B.C., (M. H. Ruhmann).
* *Peleteria arctica* Mall. Cockburn Point, N.W.T., Sept. 5, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 57.

Sarcophagidæ.

* *Meloposarcophaga tothilli* Parker. British Columbia, Savary Island, June 13-31, 1917, (R. S. Sherman); Can. Ent. LI., 155.

Sarcophaga communis Park. Walhachin, B.C., (E. R. Buckell).

512. *Sarcophaga helicis* Towns. Kelowna, B.C., June 13, 1918, (R. C. Treherne).

Sarcophaga planifrons Ald. Walhachin, B.C., (E. R. Buckell).

Muscidæ.

* *Phormia caerulea* Mall. Bernard Harbour, N.W.T., May 24, 1915; June-July, 1915-1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 58.

Pyrellia cyanicolor Zett. Vernon, B.C., May 30, 1917, (M. H. Ruhmann).

Anthomyidæ.

* *Phaonia imitatrix* Mall. Bernard Harbour, N.W.T., July, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 61.
* *Phaonia minima* Mall. Nome, Alaska, Aug. 21, 24, 25, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 61.
* *Mydaeina obscura* Mall. Bernard Harbour, N.W.T., Aug. 4, 1915, June, 1916, (F. Johansen); Colville Mts., Wollaston Peninsula, Victoria Island, July 22, 1915, (D. Jenness); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C., Diptera, p. 62.
* *Aricia borealis* Mall. Bernard Harbour, N.W.T., July, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C. Diptera, p. 64.
* *Alliopsis obesa* Mall. Bernard Harbour, N.W.T., June, 1915-16, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 70.

547. *Limnophora narona* Walk. Walhachin, B.C., July 17, 1918, (E. R. Buckell).

548. *Anthomyia albicincta* Fall. Vernon, B.C., Aug. 1, 1917, (M. H. Ruhmann).

* *Helina fletcheri* Mall. Radisson, Sask., July 30, 1907, (J. Fletcher); Can. Ent. LI. 274.

* *Helina tuberculata* Mall. Rigolet, Labrador, July 18, 1906: Can. Ent. LI. 277.

550. *Anthomyia pratincola* Panzer. Vernon, B.C., Aug. 1, 1917, (M. H. Ruhmann).

* *Hydrophoria arctica* Mall. Cockburn Point, Sept. 5, 1914, (F. Johansen); Bernard Harbour, N.W.T., June, 1915, (F. Johansen): Rep. Can. Arctic Exp. 1913-1918, Vol. III, Part C, Diptera, p. 69.

* *Hylemyia acrostichalis* Mall. Nome, Alaska, Aug. 21, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 72.

* *Hylemyia quintilis* Mall. Godbout, Que., July 25, 1918, (E. M. Walker); Can. Ent. LI. 274.

* *Hylemyia pedestris* Mall. Godbout, Que., July 25, 1918, (E. M. Walker); Can. Ent. LI. 274.

* *Hylemyia spinosissima* Mall. Port Hope, Ont., June 13, 1897, (W. R. Metcalfe); Can. Ent. LI. 95.

* *Phorbia brevitarsata* Mall. W. of Konganevik, Camden Bay, Alaska, June, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 73.

558. *Pegomyia ruficeps* Stein. Vernon, B.C., (R. C. Treherne).

* *Pogonomyia quadrisetosa* Mall. W. of Bernard Harbour, N.W.T., July 14, 1916, (F. Johansen): Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 66.

* *Pogonomyioides atrata* Mall. Bernard Harbour, N.W.T., July 7, 1915, (F. Johansen): Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 67.

* *Coenosia fuscifrons* Mall. Brockville, Ont., Aug. 12, 1903, (W. R. Metcalfe); Ottawa, Ont., Aug. 17, 1907, (J. Fletcher); Port Hope, Ont., May 14, 1897, (W. R. Metcalfe); Can. Ent. LI. 96.

563. *Schoenomyza chrysostoma* Loew. Vernon, B.C., Aug. 19, 1917, (M. H. Ruhmann).

Scatophagidæ.

* *Gonatherus atricornis* Mall. Bernard Harbour, N.W.T. and Cape Krusenstern, July 3, 1919, (F. Johansen): Rep. Can. Arctic Exp. 1913-1918, Vol. III, Part C, Diptera, p. 77.

* *Cordylurella subvittata* Mall. Bernard Harbour, N.W.T., July 18-19, 1915, (F. Johansen): Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 78.

* *Dasypleuron tibialis* Mall. Collinson Point, Alaska, June 20, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 79.

* *Allomyia unguiculata* Mall. Chantry Island, Bernard Harbour, N.W.T., July 17, 1916, (F. Johansen): Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 80.

Helomyzidæ.

* *Neoleria rotundicornis* Mall. Nome, Alaska, Aug. 24-25, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 83.

* *Oecothea aristata* Mall. Bernard Harbour, N.W.T., Aug. 1-7, 14, Sept., 1915; July 10, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 82.

573. *Tephrochlamys rufiventris* Mg. Vernon, B.C., April 12, 1915, (M. H. Ruhmann).

Borboridæ.

* *Leptocera transversalis* Mall. Collinson Point, Alaska, June 13, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 53.

Sciomyzidæ.

580. *Tetanocera plumosa* Loew. Lillooet, B.C.; Vernon, B.C., (M. H. Ruhmann).

Sapromyzidæ.

582. *Palloptera jucunda* Loew. Creston, B.C., Sept. 19, 1918, (R. C. Treherne).

Ortalidæ.

592. *Anacampta latiuscula* Loew. Vernon, B.C., (R. C. Treherne).

595. *Chrysomyza demandata* Fab. Vernon, B.C., July 5, 1918, (M. H. Ruhmann).

598. *Seoptera vibrans* Linn. Vernon, B.C., July 1, 1918, (R. C. Treherne).

Trypetidæ.

604. *Spilographa setosa* Doane. Vernon, B.C., July 17, 1919, (M. H. Ruhmann).

Piophilidæ.

* *Piophila borealis* Mall. W. of Konganevik, Camden Bay, Alaska, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part C, Diptera, p. 84.

Hymenoptera.

The following new species of saw-flies appear in the Report of the Canadian Arctic Expedition, 1913-1918, issued Nov. 3, 1919, Vol. III, Part G.

Tenthredinoidea.

* *Rhogogastera reliqua* MacG. Nome, Alaska, Aug. 21-25, 1916, (F. Johansen).

* *Euura abortiva* MacG. Herschel Island, Y.T., adults from galls on leaves of *Salix reticulata* L., July, 1915, (F. Johansen).

* *Euura arctica* MacG. Bernard Harbour and Cape Krusenstern, N.W.T, July 6, 1916, (F. Johansen).

* *Pontania atrata* MacG. Herschel Island, Y.T., July, 1915, (F. Johansen).

* *Pontania lorata* MacG. Herschel Island, Y.T., adults from galls on *Salix arctica,* July, 1915, (F. Johansen).

* *Pontania delicatula* MacG. Herschel Island, Y.T., adults from galls on leaves of *Salix reticulata,* July, 1915, (F. Johansen).

* *Pontania deminuta* MacG. Bernard Harbour, N.W.T., Aug. 16, 1915, (F. Johansen).

* *Pontania quadrifasciata* MacG. Sandstone Rapids, Coppermine River, N.W.T., July, 1915, (F. Johansen).

* *Pontania subpallida* MacG. Bernard Harbour, N.W.T., July 12, 1915, (F. Johansen).

* *Pontania trifasciata* MacG. Bernard Harbour, N.W.T., July 15, 1915 (F. Johansen).

* *Amauronematus completus* MacG. Collinson Point, Alaska, June 20, 1914, (F. Johansen).

* *Amauronematus indicatus* MacG. West of Konganevik, Camden Bay, Alaska, July 4, 1914, (F. Johansen).

* *Amauronematus digestus* MacG. West of Konganevik, Camden Bay, Alaska, July 4, 1914, (F. Johansen).

* *Amauronematus cogitatus* MacG. Demarcation Point, Alaska, June 23, 1914, (F. Johansen).

* *Amauronematus varianus* MacG. West of Konganevik, Camden Bay, Alaska, June 27, 1914, (F. Johansen).

* *Amauronematus aulatus* MacG. Barter Island, Alaskan Arctic Coast, June 16, 1914, (D. Jenness).

* *Amauronematus magnus* MacG. Bernard Harbour, N.W.T., July 15, 1915, (F. Johansen).

Braconidæ.

* *Opius downesi* Gahan. Victoria, B.C., host *Rhagoletis pomonella* (W. Downes); Proc. Ent. Soc. Wash., XXI, 164.

Ichneumonidæ.

* *Dioctes modestus* Brues. Bernard Harbour, N.W.T., Aug. 7, 12, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part G, p. 23.

* *Polyblastus arcticus* Brues. Ketchikan, Southern Alaska, Sept. 10, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part G, p. 22.

* *Aptesis nivarius* Brues. Collinson Point, Alaska, June 20, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part G, Hymenoptera, p. 21.

Formicidæ.

Solenopsis molesta Say. Found generally at points south of Penticton in Okanagan Valley, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Tapinoma sessile Say. Found generally at points south of Penticton, in Okanagan Valley, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Pogonomyrmex occidentalis Cresson. Found in Lower Okanagan, B.C., fairly common at points south of Fairview, but not common at points north of Fairview. Also found at Summerland, B.C., (R. C. Treherne and E. R. Buckell. Determined by Dr. W. M. Wheeler, who reported "first record of any species of *Pogonomyrmex* from British America."

Formica subpolita Mayr. var. *camponoticeps* Wheeler. Found at points south of Penticton, in Lower Okanagan Valley, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Formica fusca L. var. *argentea* Walker. Fairview, B.C., Vaseaux Lake, B.C., Rock Creek, B.C., Naramata, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Formica sanguinea Latr. subsp. *subintegra* Emery. Fairview, B.C., Vaseaux Lake, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Formica neogagates Em. Fairview, B.C., Okanagan Falls, B.C., Kaleden. B.C., Vaseaux Lake, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Camponotus laevigatus F. Smith. Osoyoos, B.C., June, 1919, (R. C. Treherne and E. R. Buckell).

Psammocharidæ.

* *Pompiloides canadensis* Banks. Truro, N.S., Aug. 12, (R. Matheson); Val Morin, Que., July 29, 30, (J. Ouellet); Can. Ent. LI., 82.

Apidæ.

* *Bombus neoboreus* Sladen. Bernard Harbour, N.W.T., Aug 17, 18, 1915; July 10, 1916; June 6, 21, 25; July 2, 9, 30; Aug. 7, 8, 17, 18, 1915; June 16, July 3, 1916; July 19, Aug. 10, 14, 1915, (F. Johansen): Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part G, p. 28.

Philanthidæ.

Philanthus (*Anthophilus*) *psyche* Dunn. Aweme, Man., August, 1914, (N. Criddle); Medicine Hat, Alta., July, August, 1917, (F. W. L. Sladen).

Philanthus (*Anthophilus*) *inversus* Patt. Medicine Hat, Alta., August, 1916, 1917, (F. W. L. Sladen). (What I believe to be the males of this rare species were taken by me at Medicine Hat, July, August, 1916, 1917 —F.W.L.S.).

Philanthus (*Pseuanthophilus*) *frontalis* Cr. Summerland, B.C., July, August, 1916, 1917; Medicine Hat, Alta., July, August, 1916, 1917, (F. W. L. Sladen).

Philanthus (*Anthophilus*) *multimaculatus* Cam. Vernon, Summerland, Keremeos, B.C., July, 1916, (F. W. L. Sladen).

Prosopidæ.

Prosopis ziziae Rob. Ottawa, June, 1913, (F. W. L. Sladen).

Prosopis modestus Say. Kaslo, B.C., June, July, 1906, (J. W. Cockle); Ottawa, June, July, August, 1913; Kazubazua, Que., August, 1913, (F. W. L. Sladen).

Prosopis elliptica Kirby. Kaslo, B.C., June, 1906, (J. W. Cockle):

Prosopis varifrons Cr. Ottawa, June, 1913, (F. W. L. Sladen).

Prosopis cressoni Ckll. Ottawa, June, July, August, 1913, (F. W. L. Sladen).

Colletidæ.

Colletes lacustris Swenk. Toronto, August, 1887, (W. Brodie): Ottawa, June, July, 1913, (F. W. L. Sladen).

Colletes brevicornis Rob. Aweme, Man., June, 1913, (N. Criddle).

Colletes compactus hesperius Swenk. Similkameen, Okanagan, B.C., Sept 1913, (T. Wilson).

Colletes armatus Patton. Toronto, August, September, 1885, 1890, 1893, (W. Brodie); Rostrevor, Ont., September, 1907, (A. Gibson); Kazubazua, Que., August, 1913; Hull, Que., August, 1913, on *Solidago*; Ottawa, August, September, 1913, (F. W. L. Sladen).

Colletes fulgidus Swenk. Peachland, B.C., July, 1909, (J. B. Wallis).

Colletes americanus Cr. Toronto, August, 1885, (W. Brodie); Kazubazua, Que., August, September, 1913; Ottawa, October, 1913, (F. W. L. Sladen).

Colletes similis Rob. Aweme, Man., August, 1913, (N. Criddle).

Colletes hyalinus Prov. Toronto, July to September, 1882 to 1893, (W. Brodie); Ottawa, June, July, 1913; Kirk's Ferry, Que., July, 1913; Kazubazua, Que., July, 1913, (F. W. L. Sladen).

Colletes mesocopus Swenk. Toronto, June, July, August, 1887-1893; Port Sidney, Ont., June, 1897, (W. Brodie); Kazubazua, Que., July, 1913, (F. W. L. Sladen).

Colletes eulophi Rob. Toronto, June, July, August, 1885-1893, (W. Brodie); Ottawa, June, July, 1913; Kirk's Ferry, Que., July, 1913; Kazubazua, Que., July, 1913, (F. W. L. Sladen).

Colletes phaceliae Ckll. (*Salicicola geranii* Ckll.). Teulon, Man.; Pincher, Alta., July 10, 1904, (T. N. Willing).

Odonata.

Coenagrionidæ.

* *Enallagma vesperum* Calvert. Toronto, Ont., Aug. 16, 1907, (E. M. Walker); Trans. Amer. Ent. Soc., XLV, 380.

Hemiptera.

Cicadellidæ.

* *Euscelis hyperboreus* Van Duzee. West of Kongenevik, Camden Bay, Alaska, June 27, 1914; Bernard Harbour, N.W.T., July 15, 1915, (F. Johansen): Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part F, p. 4.

Neuropteroid Insects.

Psocidæ.

Atropos pulsatoria Linn. Montreal, Que., Sept. 24, 1919, (E. H. Strickland).

Perlidæ.

* *Capnia nearctica* Banks. Bernard Harbour, N.W.T., June 25, 1915, (F. Johansen): Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part B, p. 3.

Trichoptera.

* *Analobia emarginata* Banks. Teller, Alaska, July 29, 1913, (F. Johansen). Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part B, p. 4.

Dermoptera.

Forficulidæ.

Forficula auricularia Linn. Vancouver, B.C., in house, (R. C. Treherne).

Orthoptera.

Acridiidæ.

Orphulella pelidna Burm. Fairview, B.C., Aug. 7, 1919, (E. R. Buckell). New to British Columbia.

Chloealtis abdominalis Brun. Salmon Arm, B.C., Sept. 29, 1919, (E. R. Buckell).

Xanthippus (*Hippiscus*) *vitellinus* Sauss. Fairview, B.C., (E. R. Buckell); Osoyoos, B.C., (W. B. Anderson).

Melanoplus cinereus Scud. Fairview, B.C., Aug. 7, 1919, (E. R. Buckell). New to Canada.

* *Asemoplus somesi* Hebard. Banff, Alta., (N. B. Sanson); Lake Louise, Alta, (Mrs. Schaeffer); Kitchener Glacier on Mt. Kokanee, B.C., (A. N. Caudell); Trans. Amer. Ent. Soc. XLV, 274.

Locustidæ.

Amblycorypha oblongifolia De. G. Pt. Pelee, Ont., Sept., 1905, (P. A. Taverner).

Collembola.

* *Achorutes sensilis* Folsom. Bernard Harbour, N.W.T., July 5, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part A, p. 5.

* *Onychiurus duodecimpunctatus* Folsom. Bernard Harbour, N.W.T., July 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part A, p. 6.

* *Entomobrya comparata* Folsom. Bernard Harbour, N.W.T., May, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part A, p. 13.

Thysanoptera.

Apterothrips subreticulatus Bagnall. This species was described in the Trans. Nat. Hist. Soc. of Northumberland, Vol. III, pt. 1, p. 185. The type locality is Massett, Q.C.I., collected most probably by J. H. Keen. I have also taken the species at Lillooet, B.C., July, 1918. The type is in the British Museum, (R. C. Treherne).

* *Ælothrips auricestus* Treherne. Vernon, B.C., Kelowna, B.C., July, 1917, (R. C. Treherne); Can. Ent. LI., 184.

* *Euthrips cameroni* Bagnall. Seamans, Sask., Aug. 4, 1917, (A. E. Cameron); An. Mag. Nat. Hist. IV, ninth series, 271.

* *Frankliniella varicorne* Bagnall. Seamans, Sask., Aug. 4, 1917, (A. E. Cameron); An. Mag. Nat. Hist., IV, ninth series, 269.

Acarina.

Cheyletidæ.

Cheyletus eruditus (Schrank). Montreal, Que., Sept. 24, 1919, (E. H. Strickland). First Canadian record, (E.H.S.).

Tetranychidæ.

* *Stigmaeus arcticus* Banks. Bernard Harbour, N.W.T., June 18, 1915, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part H, p. 11.

Araneida.

(Arranged according to Bank's Catalogue of Nearctic Spiders, U.S.N.M., Bull. 72. The numbers refer to the pages in the catalogue.)

Clubionidæ.

14. *Clubiona riparia* Koch. Klondike Valley, Y.T., 1919, (W. E. Cockfield).

Linyphiidæ.

* *Microneta maritima* Emer. Cockburn Point, Dolphin and Union Strait, N.W.T., Sept., 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part H, p. 4.

* *Tmeticus alatus* Emer. Cockburn Point, N.W.T., Sept. 26, 1914; Bernard Harbour, N.W.T., June 27, 1916, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part H, p. 3.

Tmeticus conicus Emer. Klondike Valley, Y.T., 1919, (W. E. Cockfield).

Epeiridæ.

41. *Epeira carbonaria* Koch. Klondike Valley, Y.T., 1919, (W. E. Cockfield).
42. *Epeira diadema* Clerck. St. John's, Nfld., (A. English).

Thomisidæ.

48. *Xysticus limbatus* Keys. Klondike Valley, Y.T., 1919, (W. E. Cockfield).
49. *Coriarachne brunneipes* Banks. Klondike Valley, Y.T., 1919, (W. E. Cockfield).
51. *Tibellus oblongus* Wal. Klondike Valley, Y.T., 1919, (W. E. Cockfield).
52. *Philodromus pacificus* Banks. Klondike Valley, Y.T., 1919, (W. E. Cockfield). First Canadian record.

Lycosidæ.

* *Lycosa asivak* Emer. Bernard Harbour, N.W.T., June to September; Camden Bay, Alaska, July 4, 1914, (F. Johansen); Rep. Can. Arctic Exp., 1913-1918, Vol. III, Part H, p. 5.

Pardosa albiceps Emer. Klondike Valley, Y. T., 1919, (W. E. Cockfield).

59. *Pardosa uncata* Thor. Klondike Valley, near Dawson, Y.T., 1919, (W. E. Cockfield).

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